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September 4, 1981

Geophysical Research Letters

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Water Resour. Res., Paper 410818.

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AND FRESIOTION OF TRIDYCOMAL WELL PERPONDERS
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#### Antonio Marussi 1908-1984



Antonio Marussi, one of the most prominem geodesists of this century, died in Tri-este, Italy, on April 24, 1984, at the age of 75. Blessed with good health and a robust physical constitution for most of his life, he was struck down by amyotrophic lateral sclerosis (Lou Gehrig's disease) which he had contracted in 1982.

Marussi is best known among geodesists as

the father of modern three-dimensional geodesy. Following an initial presentation at the 1948 Oslo General Assembly of the IUGG, he published in 1949 in the Bulletin Géodésique an article entirled "Fondements de géométrie differentielle absolue du champ potential verrestre," acknowledged now as one of the seminal works of the geodetic literature. In this and subsequent papers, Marussi developed in a general, rigorous, mathematical setting a unified approach to the solution of bails geo-netric and physical problems in geodesy. obliterating the artificial distinction between horizonial and remical which had been huilt up by geodesists over many years because of observational difficulties. He thus introduced many geodesists to the 20th century by demonstrating the value and, indeed, the necessity of advance/ mathematical techniques like the tensor calculus and by anticipating useful

extraterrestrial objects like satellites. The depth and influence of this particular breakthrough, however, have been more than maiched by the innistial breadth of Martissi's contributions, encompassing the observational and instrumental as well as the theoretical,

AGU and Latin

At its meeting of May 15, the AGU

Council approved two proposals from the Committee on International Participation

(CIP) that represent the first steps in im-

plementing a policy of greater cooper-

ation and interaction with colleagues in

Latin America. The first of these calls for

a commitment of AGU funds to support

next 4 years. The second provides funds

for travel of AGU members who are fac-

ulty members in Latin American universi-

ties to come to the United States in order

These two activities were selected by the

CIP from a number of suggestions, some

of which are still retained as possible addi-

tional activities for the future. The princi-

physics in return for the limited financial

resources that AGU can put Into this ef-

fort. We wish to provide contact between

number of Latin American scientists, es-

pecially those in a position to pass the information gained to others.

man Conferences will be used mostly to

The funds authorized for the two Chap-

Pay travel costs for North American scien-

results. The goal, of course, is to promote

of Chapman Conferences between the two

scientific communities. Some of the funds

may be used to help cover costs of the

conference so that a registration fee can

be kept minimal or eliminated. It is antici-

pated that substantial support for the con-ference will be provided by the local co-

Planning and execution of the two con-ferences will be done in close cooperation

with the appropriate local scientific orga-

nizations. The principal convenors will be

sponsoring organizations.

tists to attend and present their research

the productive Interactions characteristic

in the United States and a significant

the best research in geophysics being done

IM benefit to Latin American geo

ple criterion for the selection was the

to attend an AGU national meeting and

risit appropriate research facilities.

two Chapman Conferences on appropri

ate topics in Latin America during the

**Editorial** 

American

Geophysics

data to be obtained by observations on close

and in practically every aspect of geophysics. In the international geophysical community he was renowned for his participation in a number of expeditions to Karakorum and Hindu Kush in which the tectonics and morphology were extensively analyzed in addition no the gravity and topography. At his experi-mental laboratory in the Grotto Gigante near Trieste, he designed the instruments, conducted the observations, and reduced the results for earth tide analysis and determination of the gravitational constant. The wide range of his interests was manifested by a 1975 paper un the paleohydrography of the Trieste area. Before illness curtailed his activity, he was investigating the application of altinicter data to the estimation of variations in the levcl of the Mediterranean Sea.

He was born in Trieste on October 12,

1908. After receiving a doctorate in mathematics at the University of Bologna, he joined the Istituto Geografico Militare [IGM]-the Italian geodetic and mapping agency—in Florence in 1932. During his 20 years of scrvice with IGM, he modernized its geodetic procedures, setting up the Transferse Merca-tor projection as the standard for Italian topographic maps, conversing the reference figure to the futernational Ellipsoid, and introducing more efficient modes of computing. In 1952, he accepted a professorship of geodesy at the University of Trieste, where he remained for the balance of his career. He soon made his native dry the center of gendetic research in all of Italy, Although a donsinating personality, he worked well with other people. Bruce Boh and Alan Cook both col-lahorated fruitfully with him at the Grotto Gigante Laboratory, He trained and inspired many notable geophysicists of whom probably the best known in the United States is Michele Capuro,

In 1959, he organized an international symposium on mathematical geodesy in Venice, which proved so successful that it has been continued every 3 or 4 years in halv since then, all except the last in 1981 being personally under his direction. The individnally published proceedings of these sympo-sia (now called Flotine Symposia in memory of Marussi's friend and colleague, Marin Hotine) are essential items in any worthwhile geodetic collection.

Few parts of the earth have not been visited and studied by Marussi. He was one of the first to be invited to the People's Republic of China when scientific interchange was opened in the mid-1970's. He was extremely interested in assisting developing countries and devoted much ellors to expanding geodetic expertise in Africa. Those geodesists who were privileged to attend the special

Latin American scientists, and the topics

will be selected by consultation between

gram are established, these conferences

înr all Chapman Conferences.

the local groups and the appropriate AGU

Sections. Once the topic and tentative pro-

will be treated by the standard procedures

Priority in the travel grant program will be given to faculty members who are sci-entifically active and who have little access

to funds for foreign travel. These vishors

will be enrouraged to contribute a paper

AGU will help, mostly through the Section

officers, to arrange for visits to university, government, and industrial laboratories in

which work important to the visitor is be-

ing done. These visits are expected to last

about I month, The Sub-Committee on

chaired by Selwyn Sacks of the Carnegie

Institution, will act as the selection com-

These two projects are the first concrete results of CIP deliberations on a Latin

years. The success of these efforts will de-

termine if additional programs might be productive. Fellowships to support gradu-

ate study by Latin American students are

an attractive prospect, but will require fi-

from AGU resources alone. An investiga-

tion of the kinds and amounts of support

now available for this purpose and of pos-

sible industry support for such a program must be carried out before a plan is

tential is the promotion of travel to Latin

scientists for extended periods for the purpose of working side-by-side with Lat-

in American geophysicists in their labora-tories. Encouragement of the further de-

velopment of local and regional geophysi-

AGU is the American Geophysical

Union. These decisions by Conneil em-

phasize that we are concerned with the health and further development of the

geophysical sciences in all of the Americas.

Carl Kisslinger

1974-1984

Foreign Secretary

cal societies is still another promising

evolved. Another activity with great po-

America by individual North American

nancial support beyond that available

American program during the past 2

Latin America of the CIP, corrently

mittee for the travel grants.

to the AGU meeting that they attend.

schools organized by him at the Entore Majorana in Erice, Sicily, are especially grateful for the opportunity he provided for both learning and association

Martissi was well appreciated by his govern ment and by his peers. He was president id the Italian Geodetic Commission and served as president of the International Association of Geodesy from 1967 to 1971. Among his many other honors: he is a member of the Accademia Nazionale dei Lincei, Commendatore al merito della Repubblica Italiana, order of George I of Greere, an honorary doctorate from the University of Graz, and Life Fellow of the American Geophysical Union. In 1978, to celebrate his 70th hirthday, two regular is-sues of the Nollethuo di Geodesia e Scienze Affini were combined into a special single volume entitled Modern Treads in Geodesy in which 27 of his associates, friends, and former students dedicated articles to him. Their wide range, from the representation of the earth's procutial field to the influence of geodesy on economic development, mirrors the seigle of Marussi's own interesis.

Marussi will be sorely missed in the geoderic continuity. The void caused by his ab-

sence was already evident last year at the IUGG General Assembly in Hamburg, to which he was too ill to travel. At geodetic incerings for more than 30 years, he and his inseparable companion and wife, Lori, were at the cemer of not only the scientific, but also the social proceedings. His most noticeable trait was his inexhaustible energy. On the mental side he would participate actively in any meaningful scientific, paditical, or economic discussion, and his interest would never flag. On the physical side, I particularly re-member as indicative a scene in the spring of 1978 at a rocky lieuch near Erice. My toes had warned me that the water was icy. Antonio, who was 69 at the time, shouted to come enjoy a swim with him, and he promptly dove off a protruding cray into the sea. I didn't follow his advice, but simply gazed with admiration as he enterged refreshed several minmes later. It is inevitable, nevertheless hard to believe, that this energy could finally be

This tribute was written by Bernard H. Chovitz. National Geodetic Survey, NOAA, Rachville,

#### U.S. Polar **Icebreakers**

An uneragency study of the nation's polar ice-liceaking requirements through the end of the century was recently completed. The Polar Icebreaker Requirements Study (FIRS) Group presented fleet size alternatives and recommended that the Icebreaker User Council define the capabilities required for new icebreakers. The User Council consists of representatives from the U.S. Navy. National Science Foundation, the Maritime Administration, and the U.S. Coast Chard,

Polar icebreakers are needed for three basic purposes: (1) resupply of Autactic and Greenland stations, (2) logistical support of polar operations, and (3) scientific research. One of the PIRS recommendations was that any new icebreaker designs should enhance science support while inceting the requirements for escort and logistics. The U.S. Coast Guard will soon begin the preliminary

design for a new class of polar icebreakers. The leebreaker User Council is particularly interested in hearing from the scientific com-munity what attributes future lecharaters should have to carry our sejeratic and engimeeting investigations in both polar regions. Any specific comments and thoughts on the equipment, space, and facilities for research support that U. S. icebreakers should have should be sent to AGU members Richard Hayes and Lawson Brigham at the Ice Operations Division (G-OIO), U. S. Coast Guard Headquarters, 2100 Second St., S. W., Washington, DC 20593; telephone: 202-426-1881; FTS: 426-1881. Any information will be most welcome and will be helpful in defining U. S. icebreaker capabilities for the future.

This news item was contributed by LCDR Lawson W. arigham, U. S. Coast Guard Headquarters, Washington, D.C.

#### Antarctic Research Season

As the 1984-1985 Antarctic research season gets underway, more than 300 geologists, astronomers, oreanographers, biologists, atmospheric scientists, and other researchers are preparing to travel to the south pole to study everything from solar "seismology" to the fossils of long-boried manimals. Approxi mately 96 science projects are scheduled for this, die 30th consecutive year of U.S. scientific activity at the south pole.

Atmospheric scientists will benefit from a new research facility at Arrival Heights, approximately 2 miles north of McMurdo Station, which replaces older, smaller facilities with a one-story building that will house at least six experiments after it is completed in January. Arrival Heights was chosen as the building site because it is an area of low electromagnetic noise, making it ideally suited to studies of the earth's magnetosphere. Instruments at the new facility will study naturally generated radio wave entissious, autoras, and ultra-low frequency wave activity.

Among the atmospheric science experiments is an investigation by Paul R. Guthals and a research team from Los Alamos National Laboratory to study atmospheric circulation patterns around the Antarctic continent, which may vary with the seasons. The researchers will monitor the transport of a methane tracer released into the atmosphere south of New Zealand, Japanese, French, Australian, and British investigators will take air samples at stations located around the continent, and alreraft will collect air samples between stations in support of this experi-

. This season will also see the largest and most ambitious astronomy program ever un-dertaken in Antarctica, as scientists take advantage of the clear, dry air and long observing seasons to target the sun, snas, and trear-by molecular clouds. Marrin Pomerandz of the University of Delawate's Barted Research Frandation will head a French-U.S. project to diserve oscillations of the sun that provide dues to the dynamics of the convection zone. heneath the visible surface. Poucerantz' groups will use a 12.7-cm aptical telescope equipped with a resonance spectrophotometer to such the "solar seismicity" first observed in the mid-1970's,

Other astronomy projects include infrared observations by Pomeranz of star formation in nearby molecular clouds, the first time infrared telescopes will be used since astronomers have came to the Autoretic in 1979. Following the curser of anstral winter to mid-March, Frank B. Wood of the University of Florida will begin a program (d stellar obser-vation, partly to gather thata on the suitability of the amarctic sky for astronomical studies.

One of the 1984-1985 yeason's major projeds will be an expedition be some 19 researchers from six institutions to Sevucau Island, off the east coast of the Amoretic peomsula, where in 1982 scientists discovered mammalian lossils daring from the Creticcerais-Terriary era. These tussils have been used as important evidence for commental distrand this season's expedition will mark the third U.S. visit to the island. With William Zinsmeister of Ohio State University as coordinator, the team will spend about a month (from mid-February to mid-March) examining Cretaceous-Tertiary sediments for both plant and animal forsils. In addition, they will rollect samples of sediment to my and determine if the iridium anomaly observed in sittilarly aged sediments around the world also exists in Amarctica.

lan Dalziel of the Lamoin-Doherty Geological Observatory will lead a team studying the Jones Mountain region in Ellsworth Land. which is believed to be the boundary area hetween two "microplates" of West Autorctica. The team will conduct airborne geophysical surveys of the region as part of a continuing program to try and understand the geologic nships between the eastern and west

ern halves of the continent. Oceanographers have planned a busy research season as well. A team led by Theodore D. Foster of the University of California at Santa Cruz will study a region in the Indian Ocean off the coast of Wilkes Land where there exists a layer of deep water with higher oxygen content and lower temperature and salinity than the water above or below it. The researchers will make the first physical and chemical oceanographic survey of this anomalous layer by gailiering water samples and taking data on the water's conductivity, temperature, and density. Another team headed by John B. Anderson of Rice University will take piston cores from the ocean floor in the Bellingshausen Sea and conduct seismic survevs in an effort to learn how sediments are transported from the anthretic continental shelf to the deep seafloor. They also will study sedimentation in polar fjords and collect data on the relationships between glaciers and marine sediments.

An eight-person team from the University of Wisconsin-Madisun headed by Charles R. Bentley plans to study the West Autorctic ice sheet, a region of interest to glaciologists and climatologists ulike. The tenm will lake that on the sheet's internal movement, ice physics. motion, and history, and will conduct ground-based and alrborne radar surveys to determine such factors as ice thickness and

internal structure. This research season also marks the temporary re-opening of the Siple Research Station located in the far west of Autarctica. The station has been closed since January 20 of this year (Eas, November 11, 1980, p. 906) but will re-open in November 1985 for approximately a year, after which it will be used on an as-needed basis.

News (cont. on p. 692)

### Hydrology

1100 Groundwater
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and J. & Helville
The dispersion of a tonsurvative solve produced
as a result of vertical varieties of hydraulic conductivity in a bottomen stratified appeter of
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cethod of Aris to roive the governing advectiondispersion equation describing case transport. In
the analysis, it is assured that the adul for is of
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the todraulic conductivity is a known function of the
vertical coordinate only, and the flow is unlikerection, peralled to the attralligation. The rectional, parallel to the atratilization. The applicable Aris accent equations are developed to suitable conditional (ora. Analytical colution are obtained for the saroth and first compute and to the time derivative of the accord became of the longitudinal concentration distributed for the case of an instantaneous plane source for several idealized hydraulic conductivity profiles (parabolic, linear, step-function and costne profiles (parabolic, linear, step-function and costne profiles (parabolic, accordance). The analysis gives the time-dependent variation of the longitudinal racro-dispersivity for these idealized cases throughout the transient development of the dispersion processity results of the ansiyals are applied to a light-reasonal hydraulic conductivity profile and predicted vitues of the longitudinal racrodispersivity are compared with field results. An important conclusion from the analyses is that communiformities in the hydraulic conductivity profile which persist over long distances are produce rather large values of long-lividinal cacrodispersivity, which are comparable to those observed in suce aquifers and which are much larger than the any redicted by some previous stockastic dealings. Inplications of the analyses and larger than the apprehence of the sure field dispersion problems are distanced. tosults for field dispersion problem are discussed. ISolute remaper, dispersion, racrodispersivity, etroffed equippers

Water Seyour. Res., Paper 4W076G.

OF CHIFTING THE CONCEPCT OF SCALE, INSTRUMENTATION AND SIGNASTICS IN THE DEVELOPMENT OF MULTIPHASE TRANSPORT

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Theory
J. H. Coshmin Marmon. Repartment, Tardus University.
Meet Laisyotto, Indians, 4(40)1
A recordated theory of muliphase transport is presented
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integral are also declar and or dillerant properties
internance and different instruments are allowed dedilfarent areas of action as a function of measuring
devices. (Scale, multiphase, accompanies, filter).

Water Report. Tens., Paper 484035.

Water Remout: Eas., Paper 491045.

WaterWatch News of the Hydrology Section.

Editori Mary P. Anderson, Department of Geology and Geophysics, Dalversty of Tyleousin-Madi Madison, Wt 53706 (1998-202-2396).

#### From the Incoming President of the **Hydrology Section**

On July 1 I began my ditties as president of the Hydrolagy Section of AGU, I took over a healthy Section, recognized as the leading scientific society in the field of hy drology. I also am taking over a Section whose position within AGU is strong and influential. These two facts are attibute to my predecessors, Peter Engleson and Jim Wallis, They have strepherded the Hydrology Section through an important period of technical and political growth. I will try to maintain the

During my tenute as president I butend to use our new WaterWatch column as a means of communication with the membership. I hope to keep you informed on the technical and administrative issues that arise and also to use this forum to solicit your views on directions that you would like to see us take. As a first attempt at this type of interaction, I have prepared a questiunaire, which appears below. If you have suggestions for technical sessions or Chapman Conferences, if you have views on the various AGU publication programs, or if you can suggest candidates for AGU awards, I urge you to fill out the

In talking with people about the Hydrology Section at annual meetings, I find that most members have only a vague feding for the administrative situature of the Section, I

would like to try to strip away the mystery.

The Section is administered by an Executive Committee, which consists of the President, the President-Elect, the Past President the Secretary Treasurer, the two Water Resources Rerearch editors. The two Annual Meeting Program Chairmen, the Chsirmen of the 10 Technical Committees, and several atlarge members. The day-10-day business is carried out by a subcommittee of the Executive consisting of the President, the President-Elect, the Past President, and the Secretary-Treasurer. There is an election every 2 years for the position of Secretary-Treasurer, and Tom Maddock is currently serving his second 2-year term. There is also an election for President of the Section every 2 years, but the successful candidate serves 4 years in all, 2 as President-Elect and 2 as President. Dur-President-Elect, and he will take over the presidency on July I, 1986.

There are a variety of AGU publishing outlets available in members of the Hydrology Section, and it is important that we maintain liaisms between these various nutlets. For this reason, in addition to Run Cummings and Steve Ilarges, who serve on the Executive Committee as the editors of Water Resources Research, I also intend to Invite the Hydrology Associate Editor from East, Mary Anderson, the Water Resources Monograph Board Chair-man, John Bredehoeft, and the Hydrology Associate Editor for Reviews in Geophysics and Space Physics, Bub Hirsch, to juin the Execu-

tive Committee as at-large members.

The primary function of the fectinical Committees is to organize the sessions at the two annual meetings. To this end, the chairmen of the technical committees will interact closely with the Spring Meeting (Eastern) Program Chaleman, Len Konikow, and the Fall Meeting (Western) Program Chairman, Dennis Lettenmeler (through Dec. 81, 1984 after which he will give way to Soroosh Sor-

In addition to the 10 Technical Commit-

ices, there are also four Administrative Committees of the Section of Hydrology, each with a very specific annual or biannual task. These are the Horton Award Committee, the Follows Committee, the Horton Research Grant Committee, and the Numinations

There are also a large mumber of AGUwide romnittees, and the Hydrology Section has representatives on many of them. Of par-

ticular importance to us is the Horinn Medal nmittee of the AGU Fellows Committee. The Horion Medal (not to be emfissed with our Section's Horton Award) is given in alternate years. For the 1986 competition, the Subcommittee will be chaired by John Brede-

> R. Allan Freeze President, Hydrology Section

#### **AGU Hydrology Section Questionnaire**

R. Alian Freeza bagan his laım as Prealdani ol iha Hydrology Section on July 1, 1984. Ha is anxious to hear from members of the Section as to the directions they would like to see laken over tha next 2 years. Ha la also eager to learn the names of people who might be willing to contribute to the Section or who ought to be considered for our honors and awards. If you could take the time to complete this questionneire (or any part of it), places return it to:

R. Allan Fraaze
Departmani of Geological Sciences
University of Srillah Columbia
Vancouvar, B.C. V8T 2B4, Canada

Vancouvar,	B.C. V8T	2B4, Canada	a
1. Nama: _			_

2,	Are you currently active in AGU?	Yas	
	it so, in what capacity?		
	If not in what canacity might you ha	willing to partie	SetBok

. Can you sug	est topics that you would like to see covered in technical sessions at annual meetings
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4		 pith teasiment of more aper nen formet? Possible conve	

5.	Cen you suggest interdisciplinary topics that might be aultable for joint sections at annual meetings (or at a Chapman contensnes) with other AGU asctions?

The Water Resources Monograph series published by AGU is intended as an outlet for technology transfer. Can you suggest topics that might be autled to this type of treatment at this time?

The new WaterWatch column in Eos is intended to provide an outlet for news and information of interest to members of the Hydrology Section. Do you have any suggestions regarding the content of format of the column?

8.	Water Resources Research is AGU's primary outlet for research papers in hydrology. Do you have any suggestions regarding procedures or content? Can you suggest topics (and/or possible autitors) for 1s view papers?

1	AGU Fellowship is conterred on sciantists who have "attained acknowledged aminance" in that field. The number of Fellows in the Union cannot acceed 3% of the mambership. Each Section is limited to bree or less new fellows per year. Can you suggest the names of eminent hydrologists who oughl to be considered for fellowship?

The Horton Medal is given in alternate years by AGU to a senior scientist for "outstanding contributions in hydrology. The most recent ewardses have been John R. Philip, and C. V. Thats. Can you suggest the names of aminant hydrologists who ought to be considered for the Horton Medal?

m	he Horton Award Inot to be confused with the Horton Medel) is given each year by the Hydrology fection to a researchar who has published papers of "cutstanding excellance in hydrology." The nost recent ewardess have been Dayld Woodland and Lynn Galhar. Cen you suggest the names of search hydrologists who published to be confused for the search property.
re	esearch hydrologists who ought to be considered for the Horton Award?

	The Macsiwane Award is given to three awardeaa each year by AGU for "significant contributions by a young scientist." Rsciplante must be less than 35 years of aga. The most recent awardea from the Hydrology Section was Raphaat Bras in 1982. Can you suggest the names of any young.

by a young scientist." Raciplante must be less than 38 years of age. The most recent contribution the Hydrology Section was Raphaat Bras in 1982. Can you suggest the names of any young hydrologists who ought to be considered for the Mecsiwane Award?

13. Can you suggest the names of mambers of the Hydrology Section who we members or possible candidates for future executive appointments?	uld be affective committe
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Any other comments or suggestions?	 ::		<del></del>	<del></del>	÷	_
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#### News & Announcements

#### Call for Contributions to WaterWatch

Contributions in the form of announcemems, news hems, and meeting reports, as well as letters to the editor, for the next edition of WaterWatch are due in my office on October 1. Publication is scheduled for mid-Navember.

Let me remind you that WaterWatch is ublished four times a year. I have set deadlines of January 15, March 15, July 1, and October I for receipt of nunerial. A new edifor will take over January 1.

Mary P. Anderson Editor, WaterWstch

#### 1984 Horton Research Grant Award

The recipient of the 1984 Horton Research Grant Award is Javier F. Samper. Samper it a graduate student in the Department of Hydrology and Water Resources at the University ly of Arizona-Tucson. The title of his research project is "A Methodology for the Combined Analysis of Hydrological, Hydro chemical, and Isotopic Data From Aquifers." His research advisor is Shkomo Neuman.

The objectives of his research are HI to develop theoretical and comparational tools for the sparial and statistical characterization of hydrochemical and isotopic data from aquifers and (2) to develop statistically based mathematical models incorporating hydrologic, chemical, and isotopic data to yield improved estimates of hydraulic and transport parameters as well as groundwater ages. Samper hopes to develop a workable mathematical framework which will allow a coordinated study of many types of hydrogeologic data, including hydraulic, chemical, and isotopic data. Such a systematically and mathematically based method of combined analysis for hydraulic, rhentical, and isotopic curironmental thata is needed for develop a better conceptual understanding of the hydrogeoogy of any given area and to construct more reliable mathematical models for managing groundwater supply and quality.

## Meetings

#### Modeling ET In Hydrology

A special session entitled "Evapotranip tiun Modeling: Its Verilientiun and Use" will be held during the AGU Fall Meeting in San Francisco, December 3-7, 1984.

This session will address modeling suc characterization of evapatranspiration (EI) on a macro scale and is being sponsored by the Unsaturated Zone Committee. Many ap pronches to ET in hydrology in the past have regarded it as the residual component of the water balance, but, in most terrestrial applications, ET is the largest component of the local water budget. Causal theory has been dereloped on the micro scale and is not generally a linear fraction of events on a large scale. Recent theory provides help on marro scale ET. F. Morton has recently compiled his thoughts on the complementarity of water availability for areal ET and potential ET and will give a presentation on how it works and

how it can be used. Wide area effects of energy input bear upon ET effects, and some effects need spedal characterization. Radiant energy Intera with canopy to present spectral signature effects from angle to sun ond sensor. J. Nor man will present data on the effect of these angles on albedo determination. Forests present a complex canopy to the environment. Fritachen will discuss problems and approaches of characterization and messure

ment of forest ET. Models for applied hydrology must be compatible with the local causal mechanism but must also integrate mechanisms reali cally over a wide region. J. Williams will discuss application of models, and H. Morel Services and H. Morel S toux will incorporate his work on two-phase flow into the evaporation process. J. Halfield then will discuss verification of models, a. process erucial to valid ET description.

Wide area ET requires wide area management of factors. Remote sensing offers the campability pability of synoptic and repeated measurements of many factors on a wide scale R. Jackson will discuss the use of remole sensing in ET measurement. Some cases require allowance for variance in terrain and vegetation within the larger area. R. Clappiwill discount the second seco cust relationships of remote sensing to Ef es.

timation in the humid eastern United States in those places where local anomalies in water flow path are important.

Characterization over wide areas ultimately involves mapping and correlation with local effects. R. Cuenca will describe this application and show maps for Oregon.

This program will supplemented by volu ecred papers.

Prospective contributors should send three copies of an abstract as soon as possible to either R. J. Reginato, U.S. Water Conservation Laboratory, USDA-ARS, 4331 East Broadway, Phoenix, AZ 85040 (telephone: 602-261-4356) or J. F. Sione, Department of Agronomy, Oklahoma State University, Stillwater. OK 74078 (relephone: 405-624-6417), cochairmen of the committee. In addition, an sbstract original must be sent to Meetings, AGU, 2000 Florida Ave., N.W., Washington, DC 20009, by September 12, the Fall Meeting abstract deadline. Prospective contributors

#### Petroleum Hydrocarbons

may address questions to either R. J. Regin-

sto or | F. Stone.

A conference on "Petroleum Hydrocarbons and Organic Chemicals in Ground Water-Prevention, Detection and Restoration" will be held Nov. 5-7, 1984 in Houston, Texas. The conference is being sponsored by the National Water Well Association and the American Petroluem Institute. The registration fee is \$225. For more information, con-Ian Diana Sarnovsky, NWWA, 500 W. Wilson Bridge Rd., Worthington, OH 43085.

The Weekly Newspaper of Geophysics

for speediest treatment of contributions send three copies of the double-spaced manuscript to one of the editors named below and one copy to

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Cover. Disequilibrium partial melting in the Skaergaard intrusion, East Greenland. Skaergaard ferrogabbro adjacent to the bassl contact of the later Basistoppen still appears to have been partly remelted. The original formarches a feathful has The original ferrogabbro (mottled) has separated into an anorthositic gabbro white inclusions) and a pyroxenitic gabbro (dark veins). The onorthositic gabbro is believed to be composed of the residual crystals from partial melting, and the pyroxenitic gabbro is believed to be the recrystsllized partial melt. The composition for the system FeO-CaO-SiO and may ap proximate the minimum melting compos tion for the plagioclasefree fraction of the ferrogabbro. Incomplete reaction between plagioclase and the partial melt resulted in a melt composition that does not correspond to the equilibrium entectic for the system. The ice ax in the bottom right is marked in centimeters. (Photo courtesy of H. R. Nashund, Department of Earth Sciences, Dartmouth College, Hanover, NH

#### Organics in Soils

A symposium emitted "Mechanisms of Transformations of Organics in Soils, Sediments and Groundwater" has been organized as part of the 1984 International Chemical Congress of Pacific Basin Societies 10 he held Dec. 16-2I in Honolulu, Hawali. The organizers are Donald Macalady | Colorado Schoul of Mines), John A. Cherry (University of Waterloo), and A. Otsuki | National Institute for

Environmental Studies, Ibaragi, Japanj.
There will be five sessions during the symposium: Sorption, D. L. Macalady, presiding; Groundwater Processes, J. A. Cherry, presiding; Processes in Soils and Sediments, D. L. acalady; Sorption, Transport, Disgenesis;

## Meeting Report

#### Sediment Storage

The special session on "Sediment Storage Rivers and Estuaries," which was held at the AGU Spring Meeting, included 14 pa-pers, most of which discussed an aspect of sediment storage in rivers. Two papers, one by 8 rush and another by Smith, Shoemaker and Miller covered topics in estuarine sedi-mentation. In general, the papers in the ses-sion rould be divided into two main categories: Papers that discussed long-term sedi-

mentation rates and methods of dating sediments, and papers that discussed loca-tions and mechanisms of sediment deposition. Obviously, the time scale determines not only the methods of analysis, but also the scientific questions that are asked. This was strated by the two summary papers. Meade discussed short-term sedimentation rates and the role that channel morphology and slope play in determining sites of sediment deposition. Trimble presented long-term models of sediment storage and erosion for different climatic zones.

There is much research that needs to be done in order to understand the processes of sediment deposition. Many of the papers presented in the session were case similes that detailed local controls on sediment storage. For example, Nolan and MacDonald in separate papers discussed how organic debris affects the movement and deposition of sediment. In order to be able to utedier sediment storage adequately for sediment budget modcls, we will need a beart mulerstanding of the controls that monallavial fratures, channe morphology, gravel pavenient, and other factors play in determining the sites and amounts of sediment deposition. These pa-

peri are another step in that direction. Many of the papers on long-term settiment storage were at least indirectly concerned with methods of dating the material. The papers by Brown et al. and Pavich et al. added fuel to the continuing debate about the use-fulness of loBe in claiming recent sediments and soils. Brakenridge discussed a case of progressive deposition on stream terraces in Tennessee that suggests that stream terrace treads are not necessarily time stratiguaphic markers. Perhaps we will be able to understand stream terraces better when we finder stand the mechanisms of secliment deposition. For the present, however, we are still learning about depositional processes by examining the stream terraces.

This meeting report was contributed by Karen ... Presteganril, Fronklin and Marshall College,

#### Hillslope Hydrology

A broad area of hydrology was discussed during the sestion on Hillslope Hydrology at the AGU Spring Meeting in Cincinnati. This is obvious by glancing through the abstracts, published in Eos (April 17, 1984, p. 215–216).

C. R. Amerman outlined the various flow

processes at hillslopes observed in the North Appalachian Experimental Watersheds (Cohocton. Ohio). There the sequences of geo logical strata primarily determine the existence or absence of shallow water tables, subsurface flow, and springs in spare and time.

J. A. Lynch and E. S. Corbett (School of Forest Resources, Pennsylvania State University and NEFES, U.S. Forest Service, respective demonstrated the importance of antecedent soil moisture with respect to the nin-off producing areas. Their experimental system allowed for sprinkling various parts or the whole area of a 7.9 ha forested watershed. The response hydrographs showed two peaks, their timing depending on aniecedent soil moisture (ASM) as determined with a neutron probe. At low ASM the first peak occurred shortly after the cessation of rainfall, whereas at high ASM, peak flow lagged several hours behind the cessation of rainfall. 80th presentations demonstrated once more the strenuous work involved in collecting reli-able field data and making them available for further investigation, T. Dracos (ETH Zuerich, Switzerland) used two-dimensional sand tank experiments to investigate fast groundwater response upon infiltration. He stressed the importance of hysteretical effects of the water-rontent-pressure relationship in the

capillary fringe immediately above the water lable. R. E. Smith (USDA, Fort Collins) and R. H. B. Hebbert (University of West Australia) presented their model on flow processes at the hill slope scale and compared its performance with piezometer response data that were observed in an Australian watershed. They also outlined some model applications including the assessment of soil salimity. C. 8 Burke (Harza Engineering Co., Chicagol and D. D. Gray (West Virginia University, Morgantown) introduced a finite element contonter model that combines subsurface, overland, and open channel flow. They discussed the effects of layered soils on the resulting stream hydrograph as well as the impacts of rainfall characteristics and antecedent mois Inre conditions on it. K. M. Loague and R. A Freeze [University of British Columbia] conduded the session with disenchanting comparisons of three different rainfall-runoff modeling techniques (i.e., regression model unit hydrograph model, and quasi-physically based model) on small upland carchments. They liope to improve the performance of the three models by refining the spatial ar-

rangement of the rain gauges.

The aspect of hydrological experiments and measurements at the hill slope scale fell somewhat short, and several of the presenta tions would also have fit into a program of a sessiun on Carchment Hydrology as well. The vivid discussions, however, indicated the interesis in the topics presented. Despite the fact that the program was shortened by the cancellation of two previously scheduled papers, there was not time to appreciate fully all the contributions from the 50 to 70 partici-

This meeting report was contributed by Peter F. Germann, Department of Environmental Sci-ences, University of Virginia, Charlottesville, Va.

#### Miscible and Immiscible Transport in Groundwater

The curtem conventional theory for transport of solutes in groundwater was fully developed by the 1960's. Attention then focused on the development of analytical solutions to the governing equation. By the late 1960's, the increasing efficiency of digital commuters. coupled with the restrictive assumptions required for analytical solutions, led to a major coupliasis on developing deterministic, distrib-nted-parameter, numerical simulation mentels. Several numerical modely that solved the conventional solute-transport equation were developed in the early 1970's and initially applied to scawater-intrusion problems. Toward the middle and late 1970's, many applications involved lazardous and radioactive waste disposal problems. Almost all of these applications involved miscible transport. With the increased application of transport models to field problems, certain deficiencies in transport theory were identified. The deficiencies include the mathematical descriptions of hydrodynamic dispersion, reaction processes, and flow and transport in fractured tocks.
Therefore, in the latter half of the 1970's and the beginning of the 1980's, considerable research was and continues to be directed toward improving our understanding of these

processes in the saturated zone. Also, in the 1980's, work increasingly focused on immiscible transport as more and more waste disposal sites were observed to contain nonacqueous pliase liquid (NAPL), and oil spills were noted with increasing fre-quency. In the first case, some commonly disposed chemicals, such as chlorinated hydrocarbons, are often denser than water, whereas oil or petroleum products are usually lighter than water. 80th problems involve im-

miscible transport. Because of the interest in these topics, a special session on "Miscible and Immiscible Transport in Groundwater" was included in the program of the 1984 AGU Spring Meeting. The papers covered a wide variety of research topics including (1) flow and transport in fractured rocks, (2) combining geochemistry with groundwater flow and transport, and (3) miscible transport of multiple species.

bled to discuss the process of hydrorynamic dispersion. Several questions were eddressed (I) How much have we learned in the last 10 years? (2) Why do most available models still use the conventional dispersion theory despite observed discrepancies? (3) Do new theories require too much field data to be practi-

The papers that considered miscible transport included several that emphasized chemi-cal processes. These reflect the need to incorporate chemical reactions into transport models. Different types or classes of reactions require different mathematical treatment. Sorption has commonly been represented by a distribution coefficient  $(K_d)$ . However, in many cases this approach inadequately de-scribes the actual chemical processes and the observed chemical changes.

Among the other papers on miscible flow were several that mainly emphasized the physical aspects of the problem. One presented results from a detailed field experiment in which the classical solute-transport equation was applied to field data and a good match was obtained, leading to the conclusion that the conventional advection-dispersion model



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can be successfully used for the analysis of field-scale experiments. Another considered a stratilied amifer in which the vertical companem of velocity is zero. It was then suggested that scale-dependent dispersion coefficients are a function of various averaging processes and of our knowledge (or perhaps, ignorance) of the three-dimensional spinial distribidion of the groundwater scepage vehicities.

Considerable work has recently been done on immiscible transpart. Many of the theoretical concepts and modeling approaches per-taining to this problem had originated in the petroleum industry. However, because of the lifferent physical environment of deep petroleum reservoirs compared to shallow aquilers, as well as different incentives and areas of concern in the petroleum industry, there is a great need to adapt and extend this work. Also, the physical, chemical, and hydrological processes and data needs that are imigue inhe scale and environment of shallow ground water systems need to be investigated.

Several papers on humascible transport to-cused on numerical models. Most considered three phases; air, water, and nonenpeous liqnid. Some inclinded physical, chemical, and hiological processes. Some were capable of simulating the movement of an organic in all three fluid phases. Solution of the resulting system of equations is clearly not a trivial ex-

As was indicated by the various models presented, we have come a long way in the past few years in our capability of sinulating oltiphase flow. A variety of computer codes now exist, but, as many authors have pointed out, the necessary input dara do not exist. Only one set of relative permeability curves was presented, and this was for TCE. This type of data does not exist for most solvents and chlorinated hydrocarbons found at spill sites or landfills. In addition, to characterize sites where nonaqueous liquids exist, in situ water and nonaqueous liquid saturations need to be measured or determined. Such data do not exist at these sites. Therefore, the next major advance in this problem area may not come until this type of data becomes

The Panel on Dispersion included five internationally recognized experts on dispersion; Emil O. Frind (University of Waterloo), Robert A. Greenkorn (Purdue University), Lynn W. Gelber (Massachusetts Institute of Technology), Fred J. Molz (Aliburn Universily), and George F. Pinder (Princeton University). The discussions focused nn the engths and weaknesses of the conv representation of dispersion as a Fickian process (that is, the dispersive flux is propor ional to a dispersion coefficient and the concentration gradient). There was a general consensus that the observed dispersion in the field represents the integrated effects of a variety of phenomena or processes that can lead to scale-dependent non-Ficking disper-

It is clear from the symposium that the theory and practical applications of the theory regarding chemical tronsport in groundwater epresent a relatively young and sill evolving science. First, the conventional equations do not always describe the processes adequately. Serond, available isumerical methods do not always solve the equations accurately and efficiently. Third, we never have enough data to describe the field situation unequivocably (both for physical and chemical parameters and for observations of dependent variables).

This meeting report was prepared by James W. Mercer, Geotrans, Inc., and Leonard F. Knnikow, U. S. Geological Survey.

Water Watch (cont. on p. 692)

#### **Kisiel Memorial Lectures**

The third Kiesiel Messorial Lecture was given on February 23, 1984, by John D. Bredehoeft of the U.S. Geological Sin vey. The title of his talk was "Water Management: Who are the Managers?"

The text of the second Kisiel Mentorial Lecture, which was delivered by Myron Fiering of Harvard University on March 10, 1983, is now available from the Department of Hydrology and Water Resources, University of Arizona, Tucson, AZ 85721. The cost of the 20 page booklet is \$3,700 per copy, and checks should be payable to the University of Arizona. The title of Fiering's talk was "The Real Benefits from Synthetic Flows: Rellections on 25 Years With the Horvard Water Program." According to the foreword by Nathan Buras of the University of Atizona. "The second Kisiel Memorial Lecture cap-

tures, in a sense, the kernel of the quantum jump which occurred in the late fifties and early sixties in our perception of the complexities of the hydrological phenomena and man's relation to them." According to Buras, "In the sixties, yming Ph.D.'s sallied forth from their universities into the real world spreading the good news that, at last, complex water resource problems in which imerfectly understand natural phenomena affected by anthropogenic interventions can be neatly dissected by the application of systems analysis and the use of mathematical mod-.. The second Klaiel Lecture presents and discresses a philosophical basis which underlies the discipline called 'water resources.' The philosophical hasis, together with the sci entilic formulation provided by hydrological sciences, are the conceptual framework within which the development and utilization of

Field Methods for Supporting Groundwater **Chemical Transport** Models

The growing realization that many of the challenging questions regarding contaminant transport in grundwater must be resolved by careful field experiments, led to the convening of this syntaxisium, which was spousored by AGU's Grandlwater Committee. The half-day symposium was held during the recent spring AGU meeting and attracted around 150 individuals.

The 13 papers presented included five invited talks. A list of authors and complete abstracts can be found in Eas [65, April 17, 1984, p. 206). Three papers discussed the results of controlled field tracer tests performed at the Chalk River Nuclear Laburatory and Borden landfill sites in Ontario, while three other papers covered tracer tests (one involving the use of heat as a tracer) at sites in Alabama and Illimais. One of the tests at the Chalk River site included the equivalem of 750,1000 point measurements of iodine 131 during a natural gradient tracer test at distances as far as 10 m from the injection well. These papers demonstrated that disperalon in principle can be described by the dassical advection-dispersion model provided that accurate three-dimensional velocity and permeability distributions are measured. A'hen this is done, the resulting dispersivities nre not scale dependent and are quite dose to laboratory measurements. The papers also lemonstrated that organic contanimants may be subject to chemical nonequilibrium processes during transport.

Three papers discussed an-going long-term tracer studies. D. B. Stephens described an

cussions of proldems at an inmamed hazardous waste site, at a facility by utanium mill tailings, and at the Chalk River Nuclear Lab-

The most fundamental problem in quantfring solute transport is the high degree of anisotropy and heterogeneity of materal aqui-fers. The paper by Killey and Mohyanet strikingly demonstrated that there is hope for measuring such variations, although it may be a long time before such methods become practical for widespread use. Moreover, several papers described three-dimensional experiments or analyses, implying that many are abandoning the liabit of averaging aquifer properties in the vertical direction, an ar preach which causes serious conceptual difficulties when applied to comanimant transpart. It seems that many groundwater cionamination problems are intrinsically

Hespite overwhelming measurement difficulties, it appears that existing knowledge can he applied in a useful way to salve groundwater contamination problems. The paper by Schalla et al. for example, described how an interactive and interdisciplinary approach including data gathering, kriging, model calibration, and computer simulation resulted in an evalution of a contamination problem adequate for the design of remodial action afterves. Although such successes are encouraging, perhaps the most improtant condinion of this special session was that sophisticated field measurements are necessary in onles to understand the complex phenomena associated with solute transport in groundwater in away that will allow for a general quantitaire approach to be developed.

This meeting report was written by Fred [. Molz, Anburn University, Auburn. Ala., and Mary P. Anderson, University of Picconsin-Madison, Madison, 11'rc.

News (cout. from p. 689)

## Upcoming Hearings BOOKS in Congress

The full-twing hearing has been tentatively scheduled by the Senate. Dairs and times should be verified with the committee or subcommittee holding the hearing; all offices on Capitul Hill may be reached by telephoning 202-224-3121. For guidelines on contacting a member of Congress, see AGU's Guide to Legislative Information and Contact (Eas. August 28, 1984, p. 669).

September 24: Hearing on Antarctica by the Science, Technology, and Space Subcon nuitee of the Senate Commerce, Science, and Transportation Committee, Room SD-253. Russell Senate Office Building, 9:30 A.M.—

#### Meissl Memorial Senior Scientist

Beginning in 1976, the Committee on Gepolesy of the National Academy of Sciences/ National Research Council has administered a Senior Scientist Program supported by the National Geodetic Survey of the National Oceanic and Atmospheric Administration (NOAA). Under this program, awardees have spent up to a year in residence at the National Geodetic Survey, conducting research in geodesy and related fields. Through the summer of 1984. 15 prominent scientists have participated, producing more than 20 papers ublished in a NOAA publications series or n professional journals.

The second awardee was Peter Meissl, Professor of Geodesy at the Technical University of Graz, Austria, who spent 8 months during 1977 at the National Geodetic Survey, His work, "A Priori Prediction of Roundoff Error Accomplation in the Solution of a Super-Large Gendetic Normal Equation System." was released as a NOAA professional paper, published hardbound as an acknowledgment of the permanence of the achievement. His contribution was so contstaining that he was invited to return for the summer of 1982. But, tragically, to May 1982 he was killed in a numuntain-climbing arcident near Graz.

The Committee on Geodesy and the National Geodern Survey are continuing this program, and the Committee is our rendy considering applications for periods after 1985. As a tramte to Peter Mrissl, a most dis tinguished scientist, the program benceforth will be formally designated the Peter Aleiss Memorial Schöd Scientist Program

For more information, contact Beroud IL Clawitz, Chief Geodesist, NGS/NOAA, Rorkville, Mil. 20852 (idephone: 301-443-8531).

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#### **Rock-Forming Minerals**

W. A. Deer, R. A. Huwie, and J. Zussman, vol. 1A, Orthosikiata, 2nd ed., Longman, New York, ix + 919 pp., 1982, \$149.95.

Reviewed by J. Stephen Huebner

Volume IA is the second of a series of revisions that the authors are preparing from their original five-volume work on rock-forming minerals, which is a standard reference for petrologists and mineralogists. Revision of the original series is necessary because of the explosion of the mineralogical literature, particularly in the specialities of microprobe chemical analysis, electron microscopy, intercrystalline and intracrystalline element distributions, mineral physics and thermodynamics, and phase equilibria. Many of these fields or techniques were only in their infacy when the first edition was prepared 20 years ago. The increase in the published literature has been so great that volume IA requires 5 times as many pages to deal with one half of the mineral species covered in volume 1 of the first edition. For example, mullite, which was only mentioned briefly in the sillimanite section of the original edition, is now allotted its own 17-page section. Clearly, this second edition supplants the first with regard to scope and quantity of material rovered.

Each section describing a particular mineral or mineral group includes an introduction. descriptions of the crystal structures and disliing features, and a reference list. Chemical compositions, cation distributions, experimental studies, physical properties, and paragenesis are summarized for each mineral species. The sections on chemistry, cation disibutions, and references are enlarged dramatically from those of the first edition. Surprisingly, the sections on distinguishing feaed and, as a rille, do not take advantage of new microprobe and electran microscopy techniques that help make

delinitive identification The authors callect and summarize, but do not purport to evaluate, the literature. Their make of presentation is one of vigneties, each a sentence to a paragraph long, summarizing a cited paper. Many vignettes are accompanied by reproductions of original figures. It is up to the reader to synthesize, to build bigger ideas from the collected facts. Little attempt is made to estimate the quality of the information, a lack that will be obvious to specialists but that might prove misleading to work-ers from uther fields of science.

The highly structured organization is important because the Index does little to help the reader locate particular topics. The Index regurgitates the headings within the text but adds few entires. It is little more than a suble of contents, arranged alphabetically. For example, if a subject such as diffusion in oliving does not warrant a heading, it is not likely to appear in the index, even though it may be discussed. (Self diffusion and interdiffusivity do appear, however.) As almost 300 pages are devoted to olivine alone, knowledge of

the highly structured organization is neces-sary to find information hidden within the text. Several minutes of time will be well spent in comprehending the author's scheme

ambitions field experiment at Sucritto, N. M.,

saturated media at a scale representative of

electric utility waste seepage problems. The

experiment will invulve the pulsed applica-

tion of water and tracer over a 900 m2 area

for at least 2 years. Intrinnentation will in-

clude neutron moisture probes, porous cup

throughout a 40-in thick misaurrated zone. D. L. Fryberg described an on-gining study

funded in part by the U. S. Environmental

Protection Agency involving Stanford Univer-

sity and the University of Waterlan. A natural

gradient tracer test is being performed at the

Borden Landfill site in Ontarit, where in August 1982 a solution containing two inorganic

pounds was injected into the aquiler thiring a

sampling devices. O. Güven described a trac-

er study being performed in a conlined aqui-fer near Mobile, Alabama. This study is being

funded by the U.S. Environmental Protec-

tion Agency and is designed to measure the

ertical ond lateral variations of horizontal

hydraulic conductivity by measuring the ver-

tical voriation of horizontal scepage velocities

wells operating at 15 Vs. The lung-term objec-

methods to quantify the major advective as-pects of solute transport which seem to be the

Another paper dealt with measurement of

roundwater velocity using a downhole con-

duciance electrode in a flow cell which mea-

maining three papers dealt with analyses of

field data collected to assess existing contami-

nation problems. These papers included dis-

sures the dilution of a salt tracer. The re-

in the vicinity of fully penetrating injection

tive of the experiments is to develop lield

dominant dispersing mechanism in many

tracers and five halogenated organic com-

15-hour period. Since then, solute plumes

have been monitored by using multi-level

samplers, tensiometers, and themistors placed

dimensional nature of dispersion in un-

designed to collect data for similying the

Volume IA is an excellent doorway into the mineralogical literature. It may also be the last authoritative book on orthosilicates in a field that in the future may rely upon microfiche and computer files. The reference lists are fabulous. Where else can you find 1579 printed references to forsterite-favalite: Or for that matter, 252 complete chemical analyses of garnets? With its companion vnlumes, IA is the single most convenient refer ence to, and summary of knowledge about, the major rock-forming minerals. It should be available for consultation by all mineralogists, petrologists, and, because of the newly increased coverage, geophysicists whn are interested in the physical properties of such minerals. The cost is prohibitive for man individuals, but most libraries and some specialisis will want to acquire these volumes. This new edition will be particularly valuable for institutions that have no machine-searchable reference base or that lack the primary literature from which the information in volume IA is drawn. In such institutions, volume IA will identify the papers that individuals dring research should obtain first.

J. Stephen Hnebner is with the U.S. Geological Survey, Reston, Virginia.

#### Komatiltes

N. T. Arndt and E. G. Nisbet (Eds.), George Allen & Unwin, Boston, Mass., xvii + 526,

Reviewed by Terry Klein

Since komatiites were first described in 1969, we have wondered what they are, what they look like, where they are, and how they got there. Arndt and Nisbet's well-edited, vell-illustrated volume provides a good basis and excellent resource book for the geologist that wants to know more.

Komalilles, an outgrowth of the 1979 Pen-rose Conference held in Val'Dor, Quebec, consists of seven parts with 29 chapters by 44 authors. Each part has a helpful editorial introduction that gives background citations, ends historical perspective, and summarizes the section's content. The book's purpose—
"to summarize our present knowledge of komatiites"—is accomplished well. Because the probleration of literature has slowed since he 1970's, only a few significant papers published after 1981 are missing from the reference citations.

Appropriately, Viljoen and Viljoen, who first used the term "komatiite" to describe ultramafic volcanic rocks from Barberton Mountain Land, wrote a good historical review for the introductory section. In chapter 2, editors Arndt and Nisbet answer the oftasked question, "What is a komatiite?" The editors' simple definitions of komatiltes and their associated rocks provide consistent

terms that unify the convent of komanie for

The 12 short chapters of part 2 (Regional Surveys) exemplify the wide distribution of komatiites. Viljoen et al., Ilims et al., and Auvray et al. wrote good sommary papers, and other brief chapters contain helpful ref-

Part 3 has one chapter, Spinifex-Textured Komatiites: A Review of Textures, Mineral Compusitions and Layering, by C. H. Douald-

Dimaltism's excellent, well-illustrated paper summarizes the physical and chemical characteristics of the most striking aspects of komatiites: their spinilex textures and the well-developed unineralogical and chemical layering exhibited by individual flow units.

Part 4 (Alteration and Metamorphism) ilhistrates the difficulties that accompany lexfural and geochemical studies of komatites. In the first chapter of part 4, W. T. Jolly dis cusses the metanicorphism in the Abitibi beli that aftered the kontatiites and related rocks Heaty and Taylor's communion article deals well with oxygen isotope variation in koma-

The volume's substance lies in part 5; five papers use komutine geochemistry to attempt to describe the Archean mantle and the evelution of ultramatic magness, Heswick examines chemical variations frum classic komais localities and offers several useful techniques for examining original magnasic variations in highly altered komatine suites. In an excellent chapter, Smith and Erlank suggest the possibility that different komatite lineages exist and discuss the heterogeneity of so and the changes in magniatic processes with time. A good summary chapter by Finder shows the usefulness of the Sn/Nd isotopic system in determining the age and evo of komatiites. Arndt and Nesbitt give additional information on the origins of tholeilist basalts and basaltic komatütes in the studied Manro Township area.

Although part 6 [Economic Geology] has only three papers, the number of papers u no way reflects on the quality: Naidrett and Campbell cliscuss the physical and chemical models of komatine-associated nickel depos its, and Keays explores the use of plati group metals as tools for understanding the origin of magmatic sulfides. Both are excellent papers. Pearton's chapter on the occurrence of Au and Sb mineralization illustrates the widespread, but largely unappreciated, occurrence of quartz-carbonate alteration is mafie and ultramafic rocks and Au deposits.

In the final part, two papers provide interesting reading. Bickle presents three med of estimating the MgO content of the original of estimating the MgO content of the original erupted liquid and concludes that glassy have margins are most representative. Flow many housest the presentative of the position of the content of the position of the content of the position of gins, however, are easily altered and should

be evaluated carefully.

Nisbet states in the final chapter the ice. tonle setting of komaillies is still fertile ground for speculation on small factual four dation." Nisbet summarizes aspects of the na ture of the Arthean basement, the strength of the lithosphere, and implications of observed stratigraphy; he integrates this with some models which define physical constraints of eruptive processes and produces a number of interesting tectonic speculations.

Terry Klein is with the U.S. Geological Survey, Reston, 1'A 22092.

#### Revolution in the Earth Sciences: Advances in the Past Half-Century

Shelby J. Boardman (Ed.), Kentlall/Hunt Publishing, Dubuque, Iowa, viii + 385 pp., 1983, \$23.95.

Reviewed by James T. Culmann

This volume is the proceedings of a symposium keld at Carleton College to celebrate ille 50th anniversary of its Department of Geology and to hower the founder of that department, Larry Gould, later the president of Carleton and long an internationally prominent figure in the area of polar research. The title of the volume may lead some to anticipate a more comprehensive treatment of the evolution" than its articles provide. However, its stated purpose is to illuminate just how the substantial changes of recent decades came about in each of a wide variety of areas within earth science, in effect providing a ser of case studies of the revolution. In this i succeeds admirably.

The dramatic evolution of ideas in gentectonics is not directly treated here; indeed, it would be difficult to say much that is new in doing so. Instead, most of the 31 articles in this paperbound volume focus on developments in specific fields ranging from experimenial rock deformation (considered by Tu bs and Tullis) to the geology of Antarctica (by Rowley). A noteworthy and distinguishing feature of this collection is that the articles provide lucid reviews at a level accessible to undergraduates. Especially valuable for their concise treatment of major areas are papers on advances in high pressure experimentation (by Bishop), on the development of ideas about Archean tectonics (by Southwick), on current thinking about Precambrian crustal

radingenic isotopic systems to geochronology and petrogenesis (by Bickford). Similarly, Hanor describes the development of thinking obnut subsurface sedimentary brines, Carson reviews ideas on sediment deposition and deformation at convergent margins, and Collier discusses the renaissance in invertebrate paleuntology. Also present are excellent papers on aspects of geomorphology, hydrogeology, archaeological geology, venusian tectonics, and 11 articles on topics in economic geology and mineral and energy resources. Among the latter, all of which are very deatly written, a paper by Albers on the leadership role of the U.S. Geological Survey in meeting national mineral and energy needs is porticular-

This volume is uniformly well edited and illustrated. It honors hoth Could and the department, for all its contributing authors are Carleton alumni or foculty. The volume should be in the libraries of all geology departnients because of the insights its articles provide concerning the evolution of ideas in so many areas of earth science. From these articles comes a sense of the extent to which major strides forward have depended on technological advances and/or new viewpoint commonly resulting from interdisciplinary studies. Particularly in the case of Antarctica. a third influence must be added: the spirit of international ecoperation in scientific research fostered by the man to whom this volume is dedicated, Laurence M. Gould.

fames T. Gulmaun is with the Department of Earth and Expironmental Neseuces, Wederon University, Middletown, CT 06457.

#### Early Proterozoic Geology of the Great Lakes Region

G. Medaris, Jr. [Ed.], Mem. 160, Geological Society of America, Boulder, Colo., V1 + 142 pp., 1983, \$28.00.

Reviewed by J. Kulliokoski

Interest in the Precambrian geology of the liren Lakes Region has been growing as docevolution (by Ernst) and on the application of unreaded by a new generation of multi-authored banks. Two have been published recently: the volume under review and a companion vidame, Geology and Tectonics of the Lake Superior Basin, Mem. 156. The Minnesora Geological Survey has published a regional Precambrian geological map at a scale of 1:1,000,000, and in 2 years' time newer data will appear in a DNAG (Decade of North American Geology) volume on the Precamhrian of the contentinous United States. Thus, the papers in the volume ander review provide a comprehensive view of the status of geological knowledge as it existed in the oring of 1981.

In the lead paper P. K. Sints and Z. E. Peterman guide the reader in a few pages through the subtleties of major regional geo logical features. The Animikie basin tleveloped by faulting and foundening of the general boundary between an Archean granitegreeustone terratie on the north and an older Archean gueissic terrane un die south. This basin receiveil sedimentary fill that thickened southword, and, in Michigan, volcanic rocks are intercalated with these sediments in the deeper parts of the basin. In Wisconsin the basin was filled almost entirely by lavas. The intensity of the subsequent Penokean orogeny 11,880-1,770 m.y.) recorded in the supercrustal and basement rocks, increased south ward, and tectonic transport was directed to the north. Sims and Peterman distinguish two parallel geological regions on the south side of the Penokean told helt, based on differences in structural and metantocobic patterns, but in 1981 they considered both tecunic zones to be part of a single orogen.

G. B. Morey provides details missing from the lead paper. He described the lateral and vertical variations in thickness and lithology al the fill in the western part of the Animikie basin and proposes a tectonic model of extension during sedimentation followed by compression in the succeeding Penokean orage-

Jeffrey K. Greenburg and Bruce A. Bruwn make a very strong point in their paper: It is possible tu distinguish two lower Protentzoic terranes on the hasis of contrasting geological characteristics. In the northern Penokean terrane, mostly in Michigan, Modelitic lavas and galibra sills occur with sedimentary rocks. In the Penakean volcanic belt, entirely in Wisconsin, the layer are calc-alkaline with many

associated calc-alkalic plutons, but with only minor sedimentary rocks. They conclude that these two crustrasting terranes may represent tectnostratigraphic plates that converged along the approximate site of the Niagara

The purported collision zone is analysed by D. K. Larue who recognizes distinct tectonostratigraphic terranes on either side of the fault. The very complex early Proterozoic Penokean volcanic belt, is documented by R.

Engene 1. Smith seports on four chemically and mineralogically distinct mack suites plated at 1.7 b.v. that may be the only surface expression in the area of a felsic volcanic terrane than can be traced in the subsurface possibly as far as western Arizona. R. H. Don, Jr., describes the distribution and conposition of three similar redlied quartrites, the Baraboo, Sioux, and Barron, that fell into the time span of 1.4-1.7 b.y. He proposes that because of their maturity and great thickness they were deposited along a passive continental margin, and because of the severity of their deformation, there may be a suture zone under unrthern lows and Illinois. In an important new contribution on the origin of iron formations R. W. Olakangas describes the vertical distribution pattern of characteristic classic facies in stratigraphic sequences that underlie two major from lormaions in the western part of the Animikie hasln. He concludes that the fron formations probably were deposited on a subtidal-shell enviranment

The memoir contains an excellent collection of papers that covers the subject quite well. Those who have some knowledge of Lake Superior region geology will recognize quickly that these papers represent major advarices in the quality of data and in their interpretation. The introduction of place tecionic concepts to this Proterozoic terrane is new and has not provided clear solutions to long-standing geologic problems. What it has provided is a fresh perspective on, and appreciation of, these old problems, and an exdemen to geological niectings and to the lit-

J. Kullioloski is with the Deportment of Geology and Geological Engineering, Michigan Technology Umverdty, Hangkhon, MI 49931

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Postdoctoral Research Position/Petrology-Geochemistry: Northern Illinola University, Department of Geology. Recent Ph.D. secipient is sought for one year position starting in early 1985. Strong analytical barkgrount in XRF or plasma spectrometry in preferred. The Department of Geology is in the process of ocquiring new, automated XRF and DC plasma spectrometers. The successful candidate will be involved in the development of sample-preparation, analytical, and data-reduction procedures, as well as instruction of other users. Independent or collaborative research will be expected. The Deportment also has soild-anti gas-source mass petrometers, outomated EMP, and excellent computing facilities, Please sond application, resume, and the names of three references to J.H. Berg, Departme of Geology, Northern Illinois University, 15, 1884.

nero Illinois University ls an affirmouve ac-

Satellite Geodesiat. The scientific staff position available 1 October 1984 at the Massachuse (College standard technology, Department of Larth, Anno-spheric, and Planeiary Sciencer, in a tyderally spon-sored long-term program of research in geodesy via radio interferometry with Global Positioning System (iPS) subdices Candidates must have Ph.D. in ge-odesy, and ability and experience in radio interfer-ometry with ratellites, as demonstrated by substan-ial multipations and reference reports. Expertise in oneity with ratellites, as determined by substantial publications and reference reports. Expertise in FORTRAN scientific programming, in thatistics, let the theory of satellite geodesy, and in parameter estimation techniques applicable to large, multi-parameter geodetic problems is easential. Experience in performing field work and let data processing on large IBM mainframe analor small PDF-11 computer systems would be helpful, as would knowledge of the GPS, geodetic reference systems, and network adjustments. Strong skills in oral and written presentation of research results are required.

Please send vita, including list of publications, salary requirements, and references, plus reprints of major publications to:

Professor Charles C. Counselman, 11t of L.M. Blrelietic

c/n L.M. Birchette Personnel Office, E19-238

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The University of Kansas/Faculty Positions. The University of Kansas, Department of Geology seeks to fill three tenure track positions at the Assistant Professor level to begin in Fall, 1985. The Department ment seeks persons committed to academic careers involving teaching, reserch, and service. Salaries will be determined by qualifications and experience and will be competitive. Candidates should hold the and will be competitive. Candidates should hold the Ph.D. degree in Geological Sciences or have it near

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in stratigraphy, sedimentation, sedimentory geo-temistry, or tectonics. temistry, or tectonics.

Position 2. Tectonics, with Interest in the Interface

elemistry, or lectomica, with Interest in the Interface between fectoric processes and sedimentation, igneous phenomena, or metamorphism. Duttes will include teaching courses in structural geology and tectorics or petrology. Candidates with field orientation will be prefer red.

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The University of Kansas is on AA/EEO employed and encourages opplications from all qualified persons.

University of Texas at Austin. The Department of Goological Science, collected full nature (tack pass-puly effective tall 1985 in one or more of the foltions effective tall 1985 in one or more of the fol-biolicing disciplines: 1) inferepaleonalogy, 4 entars biolicingraphs, 21 structure-teetonics, 31 hydrogend-ogy, and 4) mineralogy-kinetics. Each person by ex-pected to teach built indergraduate unit graduate courses and to conduct o vigorous research pro-gram, including the inpervision of graduate stu-dents, in the area of his or her speciality. The posi-tion require the Ph.D. degree. Applicants should ubuilt a detailed resume, touter and addresses of five references, a statement of leaching and re-search interests, and a copy of their dissertiation ab-stract by Occember 1, 1984 to: Dr. William L. Fish-er, Department of Geological Sciences, the Universitract by Occumber 1, 1964 to; Dr. Comban L. P. P. Comban L. P. P. Comban L. P. Comb

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It is expected that this individual will tievelop a

oppropriate professional societies.

It is expected that this individual will tievelop a cesearch progrom in one of the disciplines given above working in coonlinotion with ongoing programs within the STAR Laboratory ond, possibly, with other activities within the Stanford Center for Space Science and Astrophysics. It is expected that this individual will have a strong background in experimental activities in either line laboratory or in the liekl, including the environment of space; experimental activities in either line of the experimental activities of either of the experimental activities and/or electromagnetic theory will clearly be desired. It is also expected that the individual will have a demonstrated capability for accuring federal or other research grant support, or be deemed by the selection continuities of being capable of securing such funts.

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School of Engineering, and the University. It is expected that the person chosen will participate actively in the training of graduate xuderss. It is expected that this

pected that the person couch will participate active ly in the training of graduate students.

The Chairman of the selection committee for thi position is Professor Robert A. Helliwell, Professor of Electrical Engineering, Space, Telecommunications, and Radioscience Laboratory, Stanford University, Stanford, CA 94303. Other members of the selection coundities include Professor P.M. Banks,

University of Southern California/Development Technician. A candidaty is saught for a married oriented electrowecy technician position. The suc-cessful cambidate should be familiar with standard contul cambdate should be familiar with samiliarly microprocessor based occating applic mattramentation and have some lambiarity with related deployment, minimenance, and calibration practices. FOR-TRAN and/or BASIC programming experience in destrable, but not mandatory. The sandidate should be willing to spend 4-8 weeks at rea per yeas. Sdary range is \$20 -\$30K depending upon experience and qualificoloms.

qualifications.
Inquiries may be made to entier Dr. Alan
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Group, Department of Geological Sciences, SCI
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## **Associate Chief** Space Data & Computing Division

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geological hydrology.

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College of Geoaclences/Jolversity of Oklahoma.
Applications and minimations are invited for the justition of Uncertur of the School of Geology and Geophysits. The Director is expected to have a Ph.D. or equivalent, a strong, ongoing research program and administrative experience; individual experience helpful; field of geological specialization open; to hegin July 1, 1985; salary to be negotiated. In 1986, the School will move into the new 300,000 st. ft. Energy Center along with other elements of the College of Geosciences; the Oklahuma Geological Engineering and the School of Petroleum and Ceological Engineering and the School of Chemical Engineering and Materials Sciences, both from the College of Engineering.
Applications with curiculum vitae, names and ndd reses of three references, and/or nominations should be sent to:

nddreses of three references, and/or nominations should be sent to:

Francis G. Sighli, Dean College of Georgiances
University of Oklahoma
601 Elm Street, Room 458C
Norman, Ok 73019.

Consideration of applications with begin January

The University of Oklahoons is an Equal Oppor-unity/Affirmative Action Employer.

Illinois Department of Energy and Natural Re-sources/Positions Available. The Illinois Depart-ment of Energy and Natural Resources (E.NRt. Wa-ter Survey Division, is developing a Hazardons Waste Research and Information Center (HWRI). The Center is the locus of Ingardons waste research information and industrial assistance in Illinois state

Waste Research and Information Cedler (14781). The Center is the locus of ligrardons waste research information and industrial assistance in Illimois state goretument. Its tole is to provide information and technical support to industry, the public and gweetiment officials towards a comprehensive hazardous waste management strategy for the state.

DIRECTI IR.—Responsibilities: The Director will be responsible for the management and implementation of Venter activities aided by group leaders in the research, information and technical varistance programs. The Director will report to the Chief of the Illinois State Water Survey and the HATRI: Coverning Board, Initial tasks include: the evaluation of related activities at the State and Federal level, the development of efficient information charringhouse and industrial assistance program, supervision of research and facilities planning activities and acting as the principal spokespers at for the program. Qualifications: The successful cambidate will be an accomplished scientific professional with demonstrated experience in the management of a stientific research or service ptogram. An advanced degree in an apprupriate discipline is preferred. Salary of \$40,000 to \$55,000 per year will be commensurate with experience and qualifications will be responsible for the development and implementation of Center research Program Courdinator will be testionals and direct contract research and implementation of Center research program Courdinator will be well aware of the curresponding environmental and committee of HW related problems in Illinois. He/she will be well aware of the curresponding environmental and committee and interest contract research activities. The Coordinator will report to the Director of the Exerter, will directly supervise a small maff of research professionals and direct cumtant research activities. The Coordinator will report to the Director of the Exerter, will directly supervise a small maff of research professionals and direct cumtant research scien

ENGINEER/INDUSTRIAL ASSISTANCE CO-ENGINEER/INDUSTRIAL ASSISTANCE CO-ORDINA/TUR-Responsibilies; The Loordinator will be an integral part of the management team of the Uenter, respondible for the development of a com-prehensive jungram of industrial and technical as-sistance, limital tasks will include; evablishing con-tact with industry and trade groups involved in HV reduction and alternative treatment programs; prr-paring reliable procedures for the analysis of mate-rials flows and auditing to encourage waste reduc-tion, inpulied substitution, process modification; and alternatives to 14W lambifling. The Coordinator will report directly to the Director of the Center and will be expected to integrate program activities with rebe expected to integrate program activities with re-lated research and information efforts. *Qualifyra-tions:* The successful candidate will be an experi-

lated research and intorniation efforts. Qualifications: The successful candidate will be an experienced dientical process or treatment engineer, motivated towards an effective HW management strategy for Illinots' industry. He/she will have demonstrated experience in the management of waste research or service programs which addresses ruch remnental and contomic constraints effectively. Salary is \$10,000—\$30,000 per annum according in experience and the needs of the program.

TECHNICAL INFORMATION SPECIALIST—Responsibilities: This position will able in the development of a comprehensive liazardous waste information rearinghouse and HW Hodine in the Cynter. The position involves the collection of published materials on HW issues, as well as technical information for the use of Center research and technical assistance staff. Initial tasks also include the development of a highiographic data base on HW and the preparation of Issue papers for the public and legislature on various issues related to HW management. The position is under the direct impervision of the Information Program Congilhator, Qualifications: The successful camilidae should have experience in the data management and information transfer activities of a high level scientific group. Technical writing and communications skills are essential. A degree in library, comparer science, of closely related discipline is required. The salary range is \$20,000—\$25,000 pet annum, negotiable actoriting to experience.

INFORMATION PROGRAM COORDINA.

INFORMATION PROGRAM COURDINA-INFORMATION PROGRAM COURDINATOR—Reportbilites: The Coordinator will be responsible for the planning and implementation of
HW information rearing foruse and that a base development activities of the Center. He/she will report
to the Director and actively conjecture while the dailt
of the research and technical assistance programs.
The successful candidate will supervise the information and data management activities of the Course.
Qualifications: Familiarity and experience with hildographic, Information imusier and continuer-aided
reference needs of an alranced scientific group are
essential. Microromputer literacy would be useful.
Technical writing and issue assaysis experience are
prefetred with adequate actentific experience. Salaty level for this position is \$24,000—\$28,000 per
annum, negotiable according to experience.

RESEARTH SCIENTIST (2) — Responsibilities:
Appplications are snught in fill two research positions
under the direct supervision of the Research Program
Unurdinant, Initial tasks will include an assessment
of the extent, magnitude and areal concentration of
HW generation, treatment and dispusal activities in
Illinois with an emphasis on environmental and economic impacts. Industrial, economic and environmercial data must be evaluated from a variety of
suunces to provide an overview and assess the status
of autoryth United to the content of the grants.

suries in provide an overview and assess the natus of research fludings in diverse scientific research efficies in the U.S., of HW related problems towards the development of an effective waste management strategy, to-depth assessments of major waste streams streams, to-nepth assessments of major waste streams, illsjuosal and treatment practices in regional to local settings will be cunducted to better assess the research and technical needs of the state. This will entail the levelopment of relational data bases to integrate existing regulatory and natural resource data pertaining to waste management activity in the past, present and the future.

Qualitications: It is anticipated that

taining to waste management activity in the past, present and the future.

Qualifications: It is anticipated that each candidate will have at least three years experience and an advanced degree (M.S. preferred) in a basir science (hydrology, chemistry) or engineering (civil, sanitary, environmental) discipline. Research contract involvement particularly in management and cooperative participation would be useful. The successful candidates would be experted to have proven experience in stemific and engineering data base manipulation and solid writing/communication akills. The salary range is \$22,000—\$27,000 per annum negotiable on experience and how closely the candidate meets the needs of the program. Each applicant should provide a summary of relevant experience and a statement of professional goals.

INDUSTRIAL ASSISTANCE ENCINEER—Responsibilitie: This position will ald in the develop:

Siehli, Deua

Georciences

Geor

landfilling. The surrestable candulate will develop materials three enimates, self-audit and direct using ance protections, at well as an updated data base on fillinois that generation in competation with Center research and information core stall. Qualifications: Process experience in the design and implementation of wave treatment or process engineering schemes are particular. Excellent concumications and writing skills are essential. An advanced degree in viril, eltentical of environmental engineering of a closely related this iddire, is required. Safary range is \$35,000—\$10,000 per year, negotiable according to experience.

experience.
APPLICATIONS: Qualified applicants should submit their resumes and three letters of reference.

Stanley A. Changnon, Jr., Chief Illinois State Water Survey P.U. Rox 5050, Station A Changsign, H. 61820, CLUSING (VATE: November 30, 1984, The State of Illinois is arrequal opportunity/affir-mative action ruphover.

Geophysicis/University of North Carolins. The Department of Geology invites application for a tenure track faculty position in solid-earth geophysics beginning July 1, 1985. The ponition probably will be at the assistant professor level, but candidates at the assistant professor level, but candidates at the assistant professor level will be considered, in the platt, is required, and past-doctoral experience is desired. The professor level will be considered. The Platt is required, and past-doctoral experience is desired. The professor level will be considered. Faculty numbers are expected to conduct a right and active recarch program, teach graduate and undergulare students, and superrise these. Inquiries and letters of application doubt be sent in P. Geoffrey Friss, Department of facility of 29A, University of North Carolina, Chaple Hill, NC 27514. Applications must include returne, statement of teach three references. University for Applications must include returne, statement of teach three references. Closing date for applications is Detoker 19, 1984.

UNC is an allumnitive action/equal apportunity

UNC is an atternative action/equal apportunity

Head/Department of Geosciences. The Pennylvania State University seeks an academic leader to serve as Professor and Head of a large department with 35 faculty members divided among three academic programs; Geochemistry-Alineratogy, Geology and Geophyries.

A doctor's degree, significant publications and high scholarly standing are required; administrate experience is highly desirable.

Applications will be accepted nord October 15, 1984. Applications will be accepted nord Content and emriculum vitae to:

At milf Music, Chairman GSc Search Coungitice
415 Walker Buikling
University Park, 194 16802.

The Pennsylvania State University is an equal opportunity/altitimatice action employer.

portunity/altituative action employer.

Scripps traniturian of Oceanography/Geochemiatry. Applications are invited for a feutic track faculty position in the general field of geochemiaty and petrology, including iron gank/physical mathe chemistry, marine biogeos brunistry, geochemistry of sedimentary, meranna phir, and igneous rocks, furled-rock interactions, theoretical and experimental petrology, and organic geochemistry. The position will involve graduate-level teaching and the supervision of graduate-shoret teaching and the supervision of graduate student research. The level of the appulument will depend on the applicant qualifications. Applicants must hold Ph.D. degree and have demonstrated excellence and independence in research. Associate or professorial level candidates must demonstrate a strong research record in their specialization; assistant level candidates will be expected by show evidence of their potential brough publication record appropriate for their expellence and teners of recommendation. Send lener of application and curriculum viace, including description of research interest, and manues of the ce reference or Chalrunar, Graduate Department, A-008, Scripps Institution of the causingaphy, University of Caldun its, San Diego, La Julia, CA 92093, Closing date but applications is 1 November 1984.

An equal apportunity/alternatic or Associate Re-Scripps Inmitution of Oceanography/Geoch

Acadomic Administrator/Assistant or Associate Research Occurrographer. The Center for Cound Studies, Scrippi finalinting of Occurraging has no opening for a spin-justion-50% Academic Administrator/50% Assistant/Associate Research Excang-

The Center combines a wide variety of field, labo-

The Lenter combies a wide varlety of field laboratory and theoretical work in waves, current, shore processes, the fiamics of nearthure sediment transport, estuatine processes, continental shelf and marginal sens reached.

The successful cambinate will have a PhD in physical occumography or roustal steates. The level of appaintment will be determined by expensione and level of Independence in his/her field as evidenced by reviewed publication record in the scientific literature and research record. The ability and desire for Interaction with a variety of people within and untiside the University, particularly funding agencies, are essential. Knowledge of a broad spectrum of research areas is also essential. Some understanding of all inhistrative Issues, e.e. personnel and budgets, is essential.

The Administrator partion of the position is genanculy state-funded. The Research portion will be funded by the Center for 12-18 months to enable the cambidate to later obtain contract/grant funding either separately or in conperation with

funding eliher separately or in conperation other department researchers.

other department researchers.
Send resumes, including areas of research interest and list of publications, with three letters of reference by 31 October 1984 to:

Dr. Douglas L. Inman, Director Center for Coastal Studies, A-009
Scripps Institution of Oceanography.
University of California-San Diego
La Jolla, CA 92093.
UCSD is an Equal Opportunity/Assirmative Action Employer.

tion Employer.

Moeash Univorsity, Victoria, Australia: Department of Barth Sciences Cootinuing & Fixed-term (3 Year) Lectureships/Senior Lectureships in Geophysics. Commencing early 1985. One position for a scientist with research expertise in any of the oretical sciamology, solid Enrith geophysics, tectonophysics, geodynamics, or exploration geophysics, and one position for a scientist with denominated research ability in exploration seismology. Possible extension of fixed-term position to 5 years. Appointees to establish research programmes in Appointees to establish research programmes involving industry and government support, develog an undergrad tate and graduate program covering applied and theoretical geophysics, and superite Manter's and Ph.D. atudents, Applicants with expendise in thermomechanical modelling will find an environment with strong interest in mechanisms of environment with strong interest. Applications including mass deformation, fluidrock, microclamy via and physical via and physi

The University of Connecticut is expanding its program in Marine Sciences and seeks qualified candidates for the following positions. All positions require a Ph.D.



DIRECTOR **Marine Sciences Institute** 

DIRECTOR National Undersea Research Program

DIRECTOR **Connecticut Sea Grant Program** 

Apply by November 11, 1984 to:

Alexandra Van Gelder UNIVERSITY OF CONNECTICUT Research Foundation Box U-133 Storrs, CT 06268 203-486-3337.

(Search 4G119, 4G125, 4G128) AA/EOE

#### PHYSICAL **OCEANOGRAPHER** Program Manager

Science Applications International Corporation (formerly Science Applications, Inc.-SAI), a large, employee-owned research contractor for the government and private industry, has an opening for a sen-lor scientis) with a background in physical oceanography or a closely related area. Primary responsibilflies of the successful applicant will be to manage a major field measurement and data synthesis program involving principal investigators for SAIC and several leading oceanographic institutions, and to participate in business development in the areas of ocean science and engineering. Applican's should have a Ph.D. and at leas) six years post-doctorate expenence. Expected salary level is commensurate with qualifications and experience.

For more information, please con-

Dr. Paul Debrule Science Applications International P.O. Box 509

Newport, Rhode Island 02840 Telephone: (401) 847-4210

SAIC is an equal opportunity employer.

Assistant Professor/Atmospheric Sciances. A teure track assistant professor position will be available in the fall of 1985 at the University of Kansas Applicant for this ore track assistant professor position will be available in the fall of 1985 at the University of Kansas. Applicants for this position must have a Ph.D. in meteorology or atmospheric science, capability and futerest in leaching synoptic meteorology at the advanced undergraditate level, and a strong interest and potential for developing an active research program. Preferred qualificadana include posidoctoral research experience and a strong publication teorid. Duties of this position will include teaching undergraduate meteorology in a B.S. degree program, conducting a vigorous research program, and participating in the responsibilities of the Department of Physics and Astronomy, Salary will depend upon qualifications. Qualified applicants are invited to submit resumes or curricula vitae, hibliographics narrative statements of research and teaching interests, and the names, addresses, and telephone numbers of three references to Professor J.P. Davidson, Chalrman, Department of Physics and Astronomy, University of Ransas, Lawrence, KS 66045. The doing date is November 15, 1984.

An affirmative action/equal opportunity ensployer, Applications are sought from all qualified people regardless of race, religion, color, sex, disability, veteran status, national origin, age or ancestry.

Project Associate/Specialists Electron Micro-Probe
Lab, University of Wiscoosin-Madison. Strong
analytical background in quanditative EMP analysis
and familiarity with computers is required. The Lab
has a 9-spectrometer ARL SEMQ and n JEOLCO:
50-A SEM. Dutles will include instrument maintenance, instruction of students, development of protedures and analysis. Research will be encouraged.

A MS or PhD is required by Earth Science, Chemistry, Physics or Engineering, Minimum salary will be \$18,000/12 myinha with an MS, Send letter of application, franscripm, returne, and names and addresses of three references by September 15 to Dr. John W. Vallet, Department of Geology & Georgiesier, Weeks Hall, University of Wisconsin, Madison, WI 58706

Arcemal opportunity employer.

Arcental opportunity employer.

University of Utahi Structual Cenlogy/Tectonics/
Tectonophysica. The Department of Geology and Geophysics at the University of Utahi seeks applications for a tenure track position in structural geology, retunits or rectonophisics. It is anticipated that this juminal will be taked at the assistant professor level, but applications by more senior persons will be cunsidered. The position requires a Platy, with emphasis in structural geology, regional rectonics or rectonophysics. The new larnily member will have the opportunity to teach in the area of lifs or her specially and may also be assigned introductory level courses. The successful tandidate will be expected to establish a vigorous research program involving graduate sudents. The person who fills this position will join an attive program in structural geology and tectonics that includes both field projects and integrated geology/geophysics ans mechanics/fluid chemistry studies of structures in the western Cordillera. There is an excellent opportunity to tollaborate with other faculty in structural geology, sedimentology, geophysics, geochemistry and petrology, A vita, copies of publications, names of litree persons that may provide references, and a letter outlining the candidate's research and teaching interests should be sent to Dr. William P. Nash, Chairman, Department of Geology and Geophysics, University of Utah, Salt Lake Cuy, Utah 84112–1188.

Deadline for receipt of applications is December 31, 1984 with the appointment starting in September 1985.

The University of Utah is an equal opportunity/
affirmadve action employer.

#### MARINE **CHEMIST** The Chemistry Department of the Waods

Hole Oceanographic Institution plana to make a tenure track appointment as Assisiant Scientist and Invites applicalions from reseachers with interest in the field of Madne Chemistry. Applicants doctoral experience with a demonstrated Interest in natural systems and strong basic physical, arganic ar analytica chemistry background to study chemica processes in marine systema. Experience with techniques in reaction kinetics and mass spectrometry would be particularly valuable. Interested candidates should send resume, transcript, reprints and names of potential referees, to:

> Personnel Manager Box 54 P



WOODS HOLE OCEANOGRAPHIC ' INSTITUTION Woods Hole, MA 02543 An equal opportunity employer M/P/H Research Geophysicia. The U.S. Gerdogical Survey (USCS), Office of Earthquakes, Vateranues, and Engineering, Branch of Seismulogy is soliciting interest from exceptionally well-malified persons with either a record of demonstrated ability or outstanding potential fur research in one or more areas of Branch activity. The Branch of Seismolugy conducts fundamental research in the fields of earthquake prediction, network seismology, crustal structure and roleano seismology. The Branch is particularly interested in a geophysicist with expertise in the field of scinnology.

All interested persons diould submit a detailed resume of education, especiacice, summary of inserests and research intentions, and the appripriate salary level commensurate with experience by 3 Octuber 1984 to:

William Ellsworth

ber 1984 Iu:

William Ellsworth

U.S. Geological Surrey

Oranch of Sciamology

345 Middlefield Road, MS-977

Menlo Park, CA 94025.

Should a position become arailable in the Branch, you will be notified of the competitive Federal employment application requirements.

The U.S. Genlogical Survey is an Affirmative Ardon/Equal Opportunity Employer.

Physical Oceaoographer/Coastal Engineec. Evans-Hamilton Inc., an oceanographic consulting firm in Mashington, D.C. area., has an opening for a physical oceanographer/ocean engineer at the MS or PhD level. Emphasis is in numerical modeling of wind, wave, ildes, and currettis in estuary and on the shelf and also on solving related coastal engineering problems. Some experience in data acquisition and/or analysis is desirable. Salary is open. Company provides merlical and profit sharing plans. Send resume to: Duuglas J. Evans, Evans-Hamilton Inc., 954 Hungerford Drive, Rockville, MD 20850 or call SOI-762-8070.

Department Head of Plant Sciences/University of Nevada Reno. The Callege of Agriculture, University of Nevada Reno, is necking applicants for this twelre-month resure trark position. The thepartment has nineteen faculty and combinis teaching, research and extension programs in the areas of agronomy, horticulture and integrated next management. A Ph.D. in a plant science related discipline and evidence of administrative and leadership abilities are required. Closing date for applications is October 18, 1984. The publicular available January 1, 1985. Conduct Or. Elsewid Milles, Chaitman, College of Agriculture, UNB, Reno, NY 89557-0004, 762-784-48(1).

The University of Nerada Reno is an equal upportunity employer.

Northwestern University/Department of Geological Sciences. Applications are invited for a tenure track position at the assistants professor level frum persons who will complement one of the existing departmental researchs programs in structual geology, tectonics, petrulogy, ur sedimentary geology. Applicants must hold the Ph. It, degree by the time of appointment and demonstrate excellence in or strong potential for independent research in one of these fields. In addition to having a strong research cortengation the position will involve teaching at the undergraditate and graduate levels and the superrission of graduate student research. Current departmental facilities luclated VAX 11750 computer, fully antumated JEOL 733 Microprobe/SEM and high pressure and geochemical laboratories.

Leners of applications should be accompanied by a resume that includes a description of research inserests and accomplishments and teaching experience, a list of publications, and the names of at least three rests and accomplishments and teaching experience, a first of publications, and the names of at least three references. Send to: S.O. Schlanger, Chairman, Department of Geological Sciences, Northwestern University, Evauston, Illinois 60201. Chosing date for applications is November 188, 1984. We expect to fill the position for the fall of 1985.

Northwesteen University is an equal opportunity/

JPL/Meteoeologial. The Jet Propulsion Laboratory, California Institute of Technology, Invites applications for a full-time Meteorologist to work in the field of aatellite scatterometry. Candidness should possess a MS Degree in Meteorology and will address topics related to the interpretation and retification of the aatellite scatterometer data. The position requires knowledge of mesoscale meteorology, sime series analysis, and FORTRAN programming. Please submit resume to Professional Staffing, Department M40.

nt M40. Jet Proposision Laboratory California Institute of Technology 4800 Oak Grove Unive Pasadena, CA 91109. Equal Opportunity Employer M/F,

POSITIONS WANTED

Tenching und/or Research — Ceology, Paleoniology, Geophysics, Mining and Petroleum Englocering. Extensive practical and trading experience in the US and abroad. Specialis in resource explosion and development—mukibingmal with them Petrian and Trinkish. Salary and tank negotiable. Repty to Box 426. Ametican Teophysical Union, 2000 Flurida Avenue, N.W. Washington, D.C. 20009.

# <u>Meetings</u>

#### Announcements

#### Extraordinary Floods

Octaber 14-18, 1985 U.S.-China Bilateral Symposium up the Analysis of Extraordinary Flood Ecents, Nanjing, China. Sponsors: USGS, Bureau of Hydrology of the Ministry of Water Resources and Electric Power of the People's Republic of China, (Marshall E. Moss, Chief. Surface Water Branch, U.S. Geological Survey, 415 National Center, Reston, VA 22092; tel.: 703-860-6837.1

One-page abstracts should be submitted by

The theme of this bilateral symposium is the analysis of extraordinary floods, or floods that are perceived to have a vecurrence interval in excess of 50 years. The following topics will be addressed; the detection of historical floods and the uncertainties of their peak discharges and times of occurrence; frequency analysis of annual fload peaks when extraordinary floods are present in systematically gaged flood records and when historic floods are detected; the use of storm data in determining design storms and design floods; multivariate analysis of flaod peaks and flood vol-umes in the presence of historic floods and historic storms; detection of trends in flood occurrences in the presence of extraordinary floods; critique of U.S. and PRC guidelines for fland analysis that treat extraordinary floods; comparative case studies of U.S. and PRC flaod analyses (three case studies each of U.S. mid Chinese design-flaod experience). For each of the topics, particular emphasis will be placed on the effects of errors contained in the determination of flood magnitudes. Each of the fifty sympasium attendees (equally divided between the two sponsoring nations) will be expected to contribute n pn-

per under one of these topics.

The symposium will be followed by atudy tour of sites where historical floods have been documented in China.

#### Forested Watersheds

October 15-17, 1984 Symposium on Long-Term Resenrch on Forested Water-aheds, Coweeta Hydrologic Laboratory, Franklin, N. C. Sponsors: USDA Forest Service. Southenstern Forest Experiment Statlon, University of Georgia Institute of Ecology, National Science Foundation, International Union of Forestry Research Organizations, Southern Appalachian Research/Resource Management Cooperative. (June H. Cooley, Institute of Ecology, University of Georgia, Athens, CA 30602; tel.: 404-542-2968.)

The purpose of the symposium is to sumroarize and highlight the hydrologic and eco-logical research on forested ecosystems conducted at the Coweeta Hydrologic Laboratory during the past 50 years. Invited papers will cover topics dealing with basic hydrologic processes and how these processes ore altered with management practices; nutrient cycling in both terrestrial and aquatic systems and as-

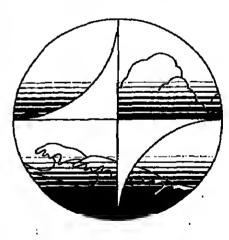
sociated processes; water shed-scale totalyses; and the application of research to manage-men needs. Invited poster presentations will describe research in pringress, including studies on heavy metal deposition and accumulation, denitribeation, analysis of the earlson evcle, and a variety of population studies for terrestrial and aquatic organisms.

In coordination with the symposium, there also will be an open house at Coweera on Detober 14, and an all-day to bineal tour of the hib on October 18.

#### Continental Crust

Oct. 24–26, 1984 Nature of the Lower Conditional Crust, London, England, Spon-sors: Geological Society, Royal Astronomital Society, Wegener Foundation, (Geological So-ciety, Burlington House, Piccadilly, London WIV OJU, England.)

This niceting brings together geophysicists. structural geologists, metamorphic petrolo-gists, and geochemists to review current rescarch on the lower continental crust.



Second Circular September 1984

#### Call for Papers IAMAP/IAPSO Joint Assembly August 5-16, 1985 Honolulu, Hawaii

Sponsors

The IAMAP/IAPSO Joint Assembly Is sponsored by the International Association of eteorology and Atmospheric Physics (IA-MAP) and the International Association for the Physical Sciences of the Ocean (IAPSO) of the International Union of Geodesy and Geophysics (IUGG).

Meetings (cont. on p. 696)

Salurday August 1

Modeling the Global Ocean/Atmosphere Climate System Special Plenaty—Com

Mannon Circular short in Ocean and

Bynaniks of Misch

TAMAP Llosing Business

LAPSO | Linning Burniess

Friday August 10

IS-4 Modeling the Global

M-2 Long Range Transport and Distribution of Trace Substances Remote Regions
M-5 Planctary Boundary Layer Physics

O-1 Fermation of the Mair

Thursday August 16

Momenta Caralle-tions its Ocean and Atmosphere

Consective Processes and their Feedback onto the Large Scale

Monwood Catenda-tions in Decam and

Lange, tree Projectes and their Feedback impatite Large Scale

Motion Traing Large Scale Motions of a The Oceans by Measure-ments of Atmosphers & Flettiens

Dinames of Mixed

PM EVE

M-7 (Overrun) O-5 (Overrun)

Timetable

0830\*-1200\*

1730\*-1900\*

#### Cosponsors

We are pleased to have the American Geo-physical Union (ACU) and the American Me-teorological Society (AMS) as our hosts, and thereby as the organizers of the Assembly. We also liope to confirm the cosponsorship of the Optical Society of America (OSA) for a

symposium relevant to their interests.
This Assembly continues the excellent cooperation that IAMAP enjoys with the World Meteorological Organization (WMO), which cosponsors the overall Assembly as well as certain symposia of particular interest to WMO. On the occasion of this Assembly, it is our pleasure to join WMO in the organization of the Fourth WMO Scientific Conference on Weather Modification.

We are looking forward to cosponsorship of the Nowcasting Ila symposium by the European Space Agency IESA). Cosponsorship of the Eumpean Ceuphysical Society (EGS) is also being sought for certain symposia.
Since this is a IAMAP/IAPSO Joint Assem-

bly, it seems only appropriate that the Scien-tific Committee on Ocean Research (SCOR) would be a cosponsor involved in the development of the scientific program from its earliest stages. We are also in the process of requesting cosponsorship from other Interna-tional Council of Scientific Unions (ICSU) bodies for symposia relevant to their interest; these include the Committee on Space Re-search (COSPAR), the Scientific Committee on Aniarctic Research [SCAR], and the United Nations Educational and Cultural Organiration (UNESCO).

#### Introduction

IAMAP and IAPSO last joined forces in an off-year joint scientilic assembly in January 1974 in Melbourite, Australia. The rapidly evolving World Climate Research Programme (WCRP) included major programs in both atmospheric and oceanic circulations and forcings, and provided strung motivation to join forces again. Large-scale atmospheric and oceanic processes, and their interactions form the care of the WCRP. The IAMAP IAPSO Joint Assembly will provide an oppor timity to arress the scientific status of these processes so crucial to climate, its variability, and its changes,

The site for the meeting, Hunolulu, Hawaii, was selected for the pleasant approaphere and climate, and the ease in accessibility from around the world.

#### Housing and Registration Information

Living accommodations for participants are available in the same facility as the Assembly, the Hilton Hawaiian Village. Rooms in this facility are large and contain two beds. The room rates range from US \$74 to \$104; thus, participants have the opportunity to halve their ronming costs by sharing a room with a

Specific Information regarding accommodations and registration will be published in the Third Circular, in January 1985.

#### Travel Funds

There are limited funds at our disposal for use in assisting participants to attend the Assembly; moreover, spread over all the sympo-sia, there is the capability to help only a very limited number of colleagues for each symposium. Participants who need some financial assistance should address their request to the respective convenor who will in turn make a recommendation to the relevant Secretarial of IAPSO or IAMAP.

#### General

All scientists are invited to participate in the Assembly. Those wishing to present a paper should inbinin an aburact. Deadline for recelpt of abstracts-March 15, 1985, This is

#### Abstract Preparation

Authors are urged to take the utmost care in preparation of their abstracts since there will be no opportunity for correction. The program and alistract hook will be prepared hy photographing the obstracts exactly as they are received with a 50% reduction for the printed abstract volume. Please use the

model abstract to prepare the final version.
The abstract page is divided intu two parts:
(a) the abstract itself and (b) the submittal information. Follow the instructions for both carefully.

a. The abstract copy must be of letter quality type. Do not exceed the maximum dimensions specified for the abstract (11.8 cm x 18 em); or the abstract will be trimmed to conform to this size.

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2. corresponding author's address (give completo address and phone number of author Sample Abstract (Sea explanation)

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Leave one line blank after title. Type names of authors in all capital letters, with affiliation and address in capital and lower case letters. Do not leave blank lines between authors.

Underscore the name of the author who will present paper.

Leave one blank line after author block. Indent paragraphs two spaces. Do not leave blank lines between paragraphs.

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1. IAMAP/IAPSO Joint Assembly

2. John E. Scott NCAR Stop 999 P.O. Box 3000 Boulder, CO 80307

3. JS-1

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ABSTRACT DEADLINE MARCH 15, 1985

Mail Original and two copies to:

Joint Assembly Meeting American Geophysical Union 2000 Florida Avenue, N.W. Washington, D.C. 20009

to whom all correspondence, acknowledgement, and acceptance should 3. indicate symposium code (example [S-1].

#### Submission of Abstracts

The ORIGINAL plus two copies of the abstruct, prepared in the format specified above, should be mailed to Joint Assembly Meeting, American Geophysical Union, 2000 Florida Ave. N.W., Washington, DC 20009 USA by the March 15 abstract deadline date. ACU will forward copies of abstracts to the appropriate convenor(s).

The deadline for receipt of abstracts is firm! Those abscracts not received by the deadline may possibly be included by the convenor in a reserve program, but it is unlikely it will be possible to include them in the program or abstract book. Abstracts containing material outside the scope of IAMAP/IAPSO activities may not be considered. Authors may submit more than one abstract; however, they may not submit the same abstract to more than one symposium. Invited speakers are

also required 10 submit an abstract. Submission of an abstract is presumed to carry with it permission for AGU to reproduce the abstract in the program and any reports related to this meeting. It is also presumed to permit the free copying of those absiracis; authors are not requested to transfer copyright. Copyright, where it exists, will

#### Provisional Schedule

This circular includes a provisional sched ule for all symposia. The schedule has been arranged to keep conflicts to a minimum. However, some topical conflicts will inevitably

No sessions will be scheduled during the first session of each Joint Symposlum or dur-ing opening and closing Plenaries. Informa-tion on business sessions will be included in the final schedule, to be distributed with the program and abstract book.

#### Joint Symposia

JS-1 The Southern Oscillation and El Nillo

Lead: IAPSO; Cosponsor: IAMAP (CCL, Convenor: G. Philander (IAPSO), CFDL/

NOAA, Princeton University, P.O. Box 308, Princeton, NJ 08342, USA. Co-Convenor: M. Blackmon (IAMAP/ CCL), ASP/NCAR, P.O. Box 3000, Boulder, CO. 80307, USA.

Papers that describe recent results concern-Ing the following aspects of El Niño and the Southern Oscilbation (ENSO) are invited; Observational (oceanographic and meteorologi-cal) studies of complete Southern Oscillation cycles, and of the development and decay of warm events; Indian and Atlantic Ocean anomalies associated with ENSO; teleconnecdons to higher latitudes, north and south; empirica) prediction of ENSO; simulation of atmospheric variability associated with a nonalous sea surface temperatures in the propics: simulation of the oceanic variability associated with the Southern Oscillation; air-sea interaction in the tropics.

JS-2 CO2 in the Ocean/Atmosphere System

Lead: IAMAP (CACCP, CCL); Cosponsor: IAPSO.

Convenor: D. Raynaud (IAMAP/CCL), Lnboratoire de Claciologie et Geophysique de l'Environment, Rue Tres-Cloitres 2, B.P. 96, F-38031, Grenoble, Cedex, France. Co-Convenor: Taro Takahashi (IA PSO), Lamont-Doherty Ceological Observatory, Pal-

isades, NY 10964, USA. The role of the oceans as source and sink of almospheric CO2 will he the central theme. Questions to be addressed include the effects of oceanic chemistry, biology and circulation on the aimospheric CO2, the influence of atmospheric circulation on the CO2 exchange at the ocean-atmosphere interface, the uptake of anthropogenic COs by the oceans an role of the ocean in interpreting the past rec-

JS-3 Monitoring the Ocean/Atmosphere System-

ords of the atmospheric COs.

Lead: IAPSO; Cosponsor; IAMAP (RC), Convenor: M. Hall (IAPSO), NOAA; Code EM-6, 6010 Executive Boulevard, Rockville, MD 20852, USA.

Co-Convenor: J. Harries (IAMAP/RC), Science and Engineering Research Council, Rutherford Appleton Laboratory, Chilton Didcot, Oxfordshire OX11 OQX, United

The symposium will address emerging observational techniques which hold promise for monitoring of oceanic and atmospheric phenomena on the scales needed for global climate research. Session papers will include satellue Instrumentation as well as in situ developments which offer new observational capabilities or unique new ways of making conventional observations. Treatment of air-sea fluxes with combinations of remote and in situ Instrumentation is of particular interest, The emphasis will be on techniques which offer efficiencies through their scale of coverage, through inherent integrating properties

(if appropriate for climate research), or through their remote sampling characteris-tics. Contributions focused on the needs of emerging programs within the World Climate Research Program (WCRP) will be sought, but discussion of new techniques with broader application is also encouraged.

JS-4 Modeling the Global OceaniAtmosphere

Lead: IAMAP (CCL, CDM, CPM); Cosponsor: IAPSO.

Cunvenur: W. Lawrence Gates (IAMAP) CDM), Department of Atmospheric Sciences, Oregon State University, Corvallis, OR 97381, USA.

Co-Convenir: Claude Frankignnul (IAPSO), Laburatoire de physique et chimie marines, Universite Pierre et Marie Curie, 4, Place Jussien, Tour 24-25, F-75230, Paris Cedex 05. France.

This symposium will focus on the design, calibration, and application of both simplified dynamical models and comprehensive models (CCMs) for the coupled global ocean/aunospliere climate system. Papers are invited for sessions on: the parameterization of physical processes in the coupled system, such as the heat and momentum fluxes in the oreanic and atmospheric surface boundary layers, and the treatment of sea ice; the sensitivity of the elimate in oceanic and/or amospheric models to variations in surface forcing, and and analysis of seasonal, interannual and dec adal variations in both the ocean and aimosphere, including the surface heat budget in both low and high latitudes, the monsoon and low-high latitude teleconnections; the use of coupled ocean/aimosphere models in estimating the climate's response to both natural and anthropogenic factors such as aerosol dust loading and CO2 concentration.

JS-5 Heat Transports; Heat and Water Budgets

Lead: IAPSO: Cosponsor(s): IAMAP (CCL CDM, RC).

Convenor: Fred Dobson (IAPSO), Ocean Circulation Division, Atlantic Oceanograpioc Laboratory, Bedford Institute of Oceanography, P.O. Box 1006, Darimouth, Nova Scotts, B2Y 4A2 Canada.

Co-Convenor: Tomlo Assi (IAMAP/CCL CDM), Ocean Research Institute, University of Tokyo, 1-15-1, Minamidai, Nakano-ku,

Tokyo 164, Japan.
This symposium will have as its central theme the elucidation of mechanisms by which meridional transports of heat and salv moisture in the ocean and atmosphere are accomplished on a global scale. Theoretical mulmerical and experimental contributions are

invited which investigate the physical processes involved, the size of the transport, and their distribution in space and time. Of particular interest will be attempts by meteorolo gists to obtain realistic estimates of the atmopheric divergences of the fluxes of heat and moisture over oceans and continents, by airsea interaction specialists to improve (and prove) the accuracy of oceanic averages of the surface fluxes, by oreanographers to investigate the partitioning of the oreanic flux es of heat and salt between the gyral and overturning circulations, and by numerical modelers to allow for interactive coupling of ocean and atmosphere.

Monday August 6

Variability of Aerosol M. 13
Optical Properties
Physical and Chemical M-4
Structure of the Ocean

Sunday August 12

WMO Fourth WMO Scien-tific Confetence on Weather Modifica-

PM WMO tount WMO Scien-

O-S

Southern Oscillation

M-14 Climate Effects of Nu-clear War O-5 Physical and Chemical Structure of the Ocean

Monday August 13

CO3 in the Chean At-

Pteria Poster Sensor on Meteorology and Physical Threamogra-

M-12 Polar and Mid-Lati-rude Neather Sys-

18-2 COom the CheanAto 18-2

WMD Jourth WMD Sten-

M-12 Polar and Middling undr Weather Sys

Sessions will be focused on presenting a co-

herent dynamical description of mid-lasisude

days to a few years. Specific topics include, but are not limited to, the geographical distri-

bution of synoptic and planetary scale vari-ability in the ocean; optimal sampling strate-gles for mapping low frequency oceanic mo-tion; the role of local and remote generating

mechanisms; coastal, equatorial, and bathy-metric influences; the interaction between ed-

dies and the mean flow between the mixed

layer and die main thermocline. Especially

encouraged are observational, theoretical,

and numerical modeling studies which offer

dynamical interpretations of observed low

Convenor: Raymond T. Pollard, Institute

of Oceanographic Sciences, Brook Road, Wormely, Goldalming, Surrey, GU8 5UB,

Uoited Kingdom.
Co-Convenor: Ian S. F. Jones, Australian
Navy Research Laboratory, P.O. Box 706,
Darlinghurst, New South Wales 2010, Australian

Parameterizations of mixed layer dynamics

on all time and space scales remoin weak for

climatic forecasting. The session will there-fore focus on observations and model simula-

tions which give new insight into the physical

processes which affect upper ocean structure,

their parameterization, and regional variab-

lity. Some emphasis will be placed on winter

mixed layer dynamics and the structure of the layer immediately below the mixed layer

which may only occasionally be modified by

frequency motions in mid-latitudes.

O-3 Dynamics of the Mixed Layer

ocean variability baving timescales of a few

terns
Dynamics and There (1-2)
modernamics of the
Founterial Ocean

Fourth WMD Scien- WMO Scien-

15-6 Monsoon Circulations in Ocean and

Lead: IAMAP (CCL, CDM); Cosponaor: TAPSO.

Convenor: C. P. Chang (IAMAP/CDM), Department of Meteorology, Naval Postgrad-uale School, Code 63, Monterey, CA 93943,

Co-Convenor: Michele Fieux (IAPSO), Laboratoire d'oceanographie physique, 42 rue Cuvier, F-75231 Paris Cedex, France.

This symposium will cover all scales of aimorpheric and oceanic motions that are related to the monsoons. For the atmosphere it will include the summer and winter mon-100ns of Asia, Africa and Australia, It will take into account observational, theoretical, and numerical studies of monsoon structure, development, variability, dynamics, interregional interactions and interactions with othr motion systems

For the ocean is will include all the Indian Ocean processes related to the monsoons, observational, theoretical, and numerical studies of the structure and variability of the ocean circulation, and thermal content, studies on the coupling between the monsoons and the

PS Precis/Poster Session on Meteorology and Physical Oceanography

Cosponsors: IAPSO and IAMAP. Convenors: Eugene LaFoud (IAPSO) La-Fond Oceanic Consultants, P.O. Box 7325, Sao Diego, CA 92107. USA, and Stan Ruttenberg (IAMAP) UCAR Projects Office, P.O. Box 3000, Boulder, CO 80307, USA.

Many types of papers require the ability to display much graphical, alpha-numeric, or pictorial material, too nuch to show using ilides. Furthermore, it is often better in some cases to be able to have one-nn-one conversations with colleagues using these display ma-terials. For these kinds of reasons, a Précis! Poster Session will be held during the Assemby for those papers for which such presentaions are the most effective way to exchange

Contributed papers covering any aspect of physica) oceanography and meteorology are welcome. They will be arranged into unifying topics by the convenors. The authors will give a three to four minute precis talk and will thisplay lus/her research on a poster board. In the oral presentation the author can use up to three slides, but there will be no questions following the presentation. Later, the author must stand by his/her poster for a specified half-day to give a detailed explanation and

answer questions regarding his/her paper. Information regarding preparation of posters, including the size of the poster board, will be supplied upon receipt of the abstract. The final schedule for oral presentation and half-day question and answer period will be forwarded to authors by the convenors in May 1985.

#### IAPSO Symposia

IAPSO Program Committee: K. Wyrtki (USA); K. Hasunuma (Japan); H. Charnock (UK); D. Halpern (USA); A. S. Sarkiysan (USSR); J. D. Woods (FRC).

O-I Formation of the Main Ocean Thermoclina

Convenor Juergen Willebrand, Institut für Meereskunde, Düsternbrooker, Weg 20, D-2300 Kiel 1, Federal Republic of Cermany. Oceanographic Institute, Wood Hole, MA 02543, USA.

This symposium will offer a forum for the discussion of current research into the processes which maintain and control the formation of the main thermocline. Questions of interest are among others: to what extent are the budgets of vorticity heat and salt (and other tracers) controlled by advective ventilation from the surface as compared to mixing; what are the influences of western boundary currents on the flow structure in the interior of the gyre; and what is the role of seasonal and interangual fluctuations in maintaining the thermocline. Papers are encouraged which deal with theoretical Investigations, including those from numerical circulation models, as well as observational studies pertinent to these topics.

0-2 Low Frequency Dynamics in Mid-Latitudes

Co-Convenor, Jens Meincke, Institut für leereskunde, Düsternbrooker Weg 20, D

2500 Klel 1, Federal Republic of Germany.

Convenor: David E. Cartwright, 103, Bld-ston Observatory, Birkenhead L43 7RA, United Kingdom. Convenor: Robert Haney, Department of Co-Convenor: Johann Lutjeharms, Nation-Meieorology, Naval Postgraduate School, Monterey, CA 93940, USA. al Research Institute of Oceanography, CSIR, P.O. Box 320, 7600 Stellenbosch, South Afri-

This symposium will cover the whole spec-

O-1 Variations of Sea Level

trum from sub-tidal variations on continental shelves, through annual and interannual variations in tropical oceans, to decade- and long-er-scale global trends relative to land level. Emphasis will be on the interpretation of sea level in terms of ocean dynamics and climate change. Contributions on modern tide-guage networks, satellite ahimetry and other techniques of space geodesy will also be welcome

PROVISIONAL SCHEDULE

Special Session on the M-2 Long-Range Trans-World Ocean Circula- port and Distribution

Second Week

Heat Transport Best and Water

Pricts Power Session on Meteotology and Physical Occasiogra-

Role of MrSea lip-teraction in Messa

Tow Frequency Dynamics in Mic Louiseles

Heat Transports. That and Water

Role of Air/Sea In-triation in Meso-icale Development

M-14 Clinate Effects of Nu- M-5 Clouds and Radiation Clear Wat Clear Wat

CD<sub>2</sub> in the Ocean At- JS: assophere System

Comparative Chua-tology of Terrestrial

WMO (Dierrun) M-9 (Overrun) M-6 (Overrun) O-2 (Overrun)

0-5 Physical and Chemical Structure of the Ocean

Convenor: H. Goie Ostlund, School of Ma-rine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, FL 33149, USA.

Co-Convenor: Wolfgang Roether, Institut für Umweltphysik, Universität Heidelberg, IM, Neuenhiemer Feld 366, D-6900 Heidelberg. Federal Republic of Cermany.

The symposium will deal with research that applies the combination of chemical and physical data sets and conrepts to the study of oceanic processes on medium and larg scales in time and spare. Included are studies utilizing both steady-state and transient trac-ers applied to mixing and transport processes in the oceans, modeling of physical and chemical processes, and implications on climate and bio-geochemistry. Paleoclimatic studies involving ocean chemistry and physics could also be reported here.

0-6 Dynamics and Thermodynamics of the

Convenor: Jacques Merle, Office de la Re-cherche de Scientific et Technique Outre-Mer (ORSTOM), 24 Rue Bayard, F-75008 Paris. France.

Co-Convenor: Cuan Binxian, Institute of Oceanology, Academia Sinica, 7 Nan Hai Road, Qingdao, People's Republic of China This symposium will focus on the physical mechanisms that determine the motion field

and the thermal state of the equatorial oceans. Questions of interest are, among others, the extent of the coupling of dynamical and thermodynamical processes, the processes controling the regions of largest variability, and the coupling with the atmosphere. Partic-

ular emphasis will be given to time depen-dent processes in the low frequency domail Studies comparing the similarities and differences among the three oceans are encouraged. Equal emphasis will be given to observational, analytical, theoretical and numerical

WOCE Special Session of the World Ocean Circulation Experiment

Convenor: Francis Breiherton, AAP/ NCAR, P.O. Box 3000, Boulder, CO 80307,

A special session on the World Ocean Clrculation Experiment is being organized. Six invited speakers will report on various aspects of this experiment.

IAMAP Symposia

M-1 Atmospheric Chemistry and Climate

Convenors: Paul Crutzen, (CACCP), Max-Planck-Institut für Chemie, Postfach 3060, D-6500, Mainz, Federal Republic of Cermany, and J. Hausen (CCL), GISS/NASA, 2880 Broadway, New York, NY 10024, USA.

This symposium will cover two interphase areas between atmospheric chemistry and cli-mate variability. 1) Climate relevance of historical and predicted chemical composition. changes of both gases and aerosol in the at-mosphere, and, 2) Climate causes of atmoapheric composition changes.

M-2 Long-Range Transport and Distribution of Trace Subtances in Remote Regions

Cosponsoring Commissions: CACGP, CPM. Convenors: R. Delmas (CPM), Laboratoire de Glaciologie de CNRS, 2, rue Tres Cloitres, F-38081 Crenoble Cedex, France, and 11. Rodhe (CACGP), Department of Meteorology, University of Stockholm, S-10691 Stock-

Emphasis will be on the long-range trans-port and deposition of both naturally occur-

Meetings (cont. on p. 698)

Maurice Ewing

**Xavier Le Pichon** 

Medalist:

#### AI-3 Clouds and Radiation

Cosponsoring Commissions: CCP, RC,

Convenors: 3A: Andrew Heymfield (GP). CSD/NCAR, P.O. Box 3000, Houlder, CO B0307, USA, and Garth Paltridge (RC). CSIRO, Division of Atmospheric Sciences, Private Bag No. 1, Mordialloc, Victoria 3195,

The effect of clouds on radiative transfer, especially the circus problem, and aspects of cloud-typing and improved parameterization by satellite (e.g., ISCCP considerations). Convenors: 3B: L. T. W. Choularton,

UMIST, University of Manchester, Sackville Street, Manchester M60 IQD, United Kingdom, and Graham Stephens, CSIRO, Division of Atmospheric Sciences, Private Bag No. 1, Mordialloc, Victoria 3195, Australia.

The effect of tadiation on the microphysics and mesometeorology of clouds. Convenor: SC: Alan Arking, Code 915, GSFC/NASA, Greenbelt, MD 20771, USA.

Unilization of earth radiation budget data for climate studies.

#### M-4 Nowcasting Ha

Cosponning Commissions: CCP, CDM,

Convenor: Keith A. Browning (CCP), Meteorological Office, Royal Signals and Radar Establishment, St. Andrews Road, Great Mal-

vern, Worcs, WR14 3PS, United Kingdom. This symposium is intended to be a brief and prediminately scientific review of the work reported at Nowcasting II, scheduled to be held at Nurrkoping, Sweden, September 1984. It will consist of mostly invited papers.

#### M-5 Planetary Boundary-Layer Physics

Cosponsoring Commissions: CDM, RC. Convenors: Peter A. Taylor, ARQL (CDAI), Atmospheric Environment Service, 4905 Duffenn Street, Downsview, Ontario, M3H 5T4 Canada, and William Large (CDM), AAP/ NCAR, P.O. Box 3000, Boulder, CO 80307,

The symposium will cover a range of toples on the structure and physics of the planetary boundary layer. Papers on the response of the planetary boundary layer to horizontal in-homogenities of the underlying surface such as coastal transition zones and not the effects of orographic or topographic features are enpecially encournged, as are papers on the physics of fluxes of moisture, gases, heat and montentum at air-water interfaces.

## M-6 Role of Air/Sen Interaction in Mesoscale

Cosponsoring Commissions: CDM, CDM WC A, and CDM WC C.

Convenors: Eric Rasmussen (CDM), Institute of Theoretical Meteorology, University of Copenhagen, Haraldsgade 6, DK-2200 Copenhagen, Denmark, and Gordon A. McBean CDM), Institute of Ocean Sciences, P.O. Box 6000, Sidney, British Columbia, V&L 4B2

The exchanges of energy, mass and momentum between the ocean and atmosphere play an important role on all scales of atmospheric energetics. This symposium will deal with the role in meioscale development, Mesoscale development mity occur as convective cloud systems and as structures embedded in larger-scale phenomena. The session will focus on observations and modeling studies that focus on understanding the physical processes and that lead to better parameterizations one session will be devoted to papers resultlng from the Storm Transfer and Response Experiment (STREX).

#### M-7 Convective Processes and their Feedback onto the Large-Scale Motion

Convenor: M. Moncriell (CDM), Atmospheric Physics Graup, Imperial College, Blackett Laboratory, Prince Conson Rood, London SW7 2AZ, United Kingdom.

This session will concentrate on the dynamical aspects of deep convection and the parameterization of convection in large-scale and inesoscale models. Theoretical aspects, numerical models and observational studies will be addressed in order that current progress can be evaluated on a broad basis

There will be special emphasis on the structure of organized convection and convective systems which are controlled by, or have a direct thermodynamic or dynamic feedback to, the basic flow.

New ideas in parameterization and the verification of schemes against observational data sets and in models will be of particular

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M-8 Weather Forecosting in the Tropics

Cosponsoring Commission: CDM. Convenne: Dave Gauntlett (CDM), Bureau of Meteorology, P.O. Box 1289K, Melbourn Victoria 300 I, Amtralia.

This symposium will provide an opponur ty for discussion muthe factors which currently determine the practical limits of deterministic weather prediction at low latitudes Thus emphasis will be placed on issues such as the impact of new observational systems, on four dimensional data assimilation, initial ization and sub-grid scale parameterization tecliniques. Papers that deal specifically with the predictability of tropical phenomena such as concentrated vortices and line disturbances are also encouraged.

M-9 Comparative Chinatology of the Terrestrial

Cosponsoring Commissions: CPAE, CCL. Convenor: Phillip B. James (CPAE), De-partment of Physics, University of Missouri, B001 Natural Bridge Road, St. Louis, MO 63121, USA.

This symposium will review the current state of knowledge concerning the climate of the terrestrial planets and their evolution. Particular emphasis will be placed upon the climate and volatile history of Mars, including relevant observations and modeling. Attention will also be given to the evolution of the terresitial atmospheres and to the use of re-mote sensing techniques to study planets oth-

#### MI-10 Clouds in Planetory Atmospheres

Cuspomnring Commissions: CCP, CPAE,

Convenut: Sushil K. Atreya (CPAE), University of Michigan, 2455 Hayward, Ann Ar-bor, MI 48109-2143, USA.

Comparative study of the cloud physics of planetary atmospheres, including relationshi of planetary clouds in radiation budget, pho tochemitry, lightning discharges, and atmospheric evolutions. Where appropriate, com-parison with the terrestrial cloud physics and morphology will be desirable.

#### M-11 Remote Sensing Over the Polar Regions

Cosponsoring Commissions: CPM, RC. Convenors: Erhardt A. Ruschke (RC., SGAR), University of Kolu, Kerpener Straise 13, 5000 Koln -II, Federal Republic of Germany, and R. J. Renard (CPM), Department of Leteorology, Naval Postgrarlitate School, Moneterey, CA 93943, USA.

The symposium will tevlew current rentote sensing recliniques including observations from satellites and automatic weather stations and the tesults obtained, providing an im-proved knowledge of the physical characteristics of the land and ocean surfaces and of the neteorological elements of the polar regions: but will not review data relay or platform location technical problems.

#### M.12 Polar and Midlotitude Weother Systems

Cosponsoring Commissions: CDM, CPM. Convenors: Dave Bromwich (CPM), Institute of Polsr Studies, Ohio State University, Columbus, OH 43210, USA, and S. Tibaldi (CDM), ECMWF, Shinfield Park, Reading.

Berkshire RC2 9AX, United Kingdom. The symposium will examine relationships between the larger-scale weather systems in the polar regions and those at midlatitudes on timescales of days to seasons. The symposiom will examine the larger-scale weather systems in polar and middle latitude regions and their interaction.

#### AI-13 Variability of Aerasol Optical Properties

Corporsoring Commissions: CACGP, CCL,

Convenors: Ardash Deepak, (RC), Inatitute for Atmospheric Optic and Remote Sensing (1FAORS), P.O. Box P. Hampton, VA 23666, USA, and Robert Dickinson, (CCL), AAP/ NCAR, P.O. Box 3000, Boulder, CO 80307.

Emphasis will be on the following subject: ral vanisbility, and statistics of optical effects in the atmosphere due to aerosols, including radiation transmittance, scattering, and ab-

#### M. 14 Climate Effects of Nuclear War

Cospomoring Commissions: CACCP, CCL

Convenors: Barry Pittock (CCL), CSIRO, Division of Atmospheric Science, Private Bag No. 1, Mordiallnc, Vietoria, 8195, Australia, and Steve Schneider (CCL), ASP/NCAR, P.O. Box 3000, Boulder, CO 80307, USA.

This symposhum will deal with the climate/ nvironmental effects of nuclear war, and will nclude a report of the SCOPE-ENUWAR project. Contributed papers in the following areas will be considered for inclusion:

a. Materials injected into the atmosphere including papers on fire extent, fuel loadings smoke composition, dust, and gaseous prod

b. Optical, micro-physical and chemical properties and behavior of injected materials.

c. Mesoscale processes, including plume rise, scavenging, atmospheric dispersion, changes in vertical stability, etc.

d. General circulation and climate, including surface temperature, duration of effects, hemispheric transport, visible and ultraviolet light intensities.

e. Climate impact assessment, including effects on animals, crops, and natural terrestrial and acquatic ecosystem

M-15 Tracing Large-Scale Motions Over the Oceans by Measurements of Atmospheric Electricity

Cosponsoring Commission: CAE. venor: Haus Dolczalek, (CAE) Coastal Sciences Program, Office of Naval Research, Arlington, VA 22217, USA.

Tracing atmospherie motions over the sea contributes to the study of air-sea interaction, formation of internal and general boundary layers, energy transfer between air and ocean, and to several remote sensing methods. Atmospheric electricity methods offer some potential not duplicated by other methods (WMO Tech. Note 162): Ions can be traced down to 10 to the minus 17 parts, moving with the air, influencing the easily measured electric field and current density Air-earth current is influenced by air motions aloft. Equipotential surfaces, easily determined, reflect air motions. The purpose of this symposium is to initiate by a small number of papers a discussion on potential and limitation and on the scope of oceanographic and manne-meteorological needs.

#### Joint WMO/IAMAP Symposium

WMO Fourth IVMO Scientific Conference on Weather Modification

Program Committee: R. G. Soulage (France), Chairman; F. C. de Almeida (Brazill; I. I. Bertsev (USSR); A. Gagin (Israel): W. F. Hitschfeld (Canada); R. L. Lavoic (USA); Ma Peimin (PRC); L. R. Koenig (WMO Secretariat).

Topics of the Symposlum:

Physics of Precipitation Processes
 Enterging Techniques of Sensing Microphysical and Dynamical Properties of Clouds

c. Scientific Basis for Evaluating Weather Modification Experiment

d. Status of Precipitation Modification and e. Review of Developmenta as Reported in

Recent Meetings f. Future of Weather Modification

Potential authors should send an abstract of their contribution to reach WMO by Novembet 15, 1984. The program committee will review these abstracts and notify authors of their decisions regarding the inclusion of their papers in the symposium. Final papers should be four to six pages in length and be prepared in sufficient time to reach WMO by February 15, 1985. These papers will Be published by WMO in a "Proceedings." Abstracts and papers should be sent to: Secretary General, World Meteorological Organization, Weather Modification Symposium, Gase Postale No. 5, CH-1211 Ceneva 20, Switzerland.

#### Related Meetings

The IAMAP Commission on Meteorology of the Upper Atmosphere (ICMUA) will be meeting with the International Association of Ceomagnetism and Aeronomy (IACA) at their Scientific Assembly in Prague, August 1985. For information regarding the IAGA Scientific Assembly, please contact: Mike Cadsden, Secretary-General, IACA, Department of Natural Philosophy, Aberdeen University, Aberdeen AB9 2UE, United King-

The symposia and workshops which CMUA is cosponsoring and co-organizing are described below. For more information regarding them please contact: Adoph Ebel, Secretary, CMUA, Institut für Ceophysik und Metcorologie, Universität Köln, D-5000 Köln 41, Federal Republic of Germany.

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Symposium 8: Rodiation and Chemistry in the

Sponsors: IAGA, Interdisciplinary Commission on the Middle Atmosphere (ICMA) and IAMAP, International Commission on the Meteorology of the Upper Atmosphere (ICMUA).

Convenor: J. Taubenheim (CDR). Co-convenor: P. G. Simon (Belgium).

8.1 UV Radiances, Cross Sections, Pho-

Atmosphere 8.5 Long-Lived Species including Results of MAP-GLOBUS

sults of MAP-CAMP

Symposium 11: Dynamics and Remote Sensing of the Middle Atmosphere.

Sponsors: IAMAP, International Commission on the Meteorology of the Upper Atmo sphere (ICMUA) and IAGA, Interdisciplinary Commission on the Middle Atmosphere (IĆMA).

firmed).

Co-convenue: A. Eliel (FRG). to the observation, interpretation and modeling of dynamical processes in the middle atmusphere (about 20-110 km beight). Coupling of the middle atmosphere with the noposphere and higher the maspheric layers vill also be discussed. One of the main topks atmospheric waves (gravity, tidal and planemensional). Symposium 11 is organized in close cooperation with Symposium 8 (radiation and chemistry in the middle armo-

11.2 Dynamics of the Stratosphere, io-

11.4 Circulation Models of the Middle

11.6 Climntology of the Middle Atmo-

and Transport in the Middle Atmosphere 11.8 Winter in Northern Europe Includ-Ing Results from MAP-WINE

#### Acronyms

ICACCP IAMAP Commission on Atmospheric Chemistry and Clobal Pollution

IAMAP Commission on Cloud Physics ICDM 1AMAP Commission on Dynamic Meteorology

ICMUA IAMAP Commission on Meteorology of the Upper Annosphere IAMAP Commission on Planetary Atmospheres and their Evolution ICPAE

International Council of Scientific Unions International Ozone Commission International Radiation Commission

IUCC International Union of Ceodesy and Geophysics

IAVCEI International Association of Volcanology and Chemistry of the Earth's Interior

Joint Scientific Committee (for the WCRP, ICSU/WMO)

WRCP. WMO World Meteorological Organization

World Climate Research Programme

Middle Atmosphere Workshaps

Chairman: J. M. Forbes (USA).

During the two years prior to the ICMUA

meeting in Prague the working group will

have examined rarious aspects of deflucing

tides from data time series, including spectral analyses, filter methods, Fourier fits, and ad-

dressing such questions as 'variability' and

measures of 'micertainty' in derived tidal

One purpose of the 1/2 day workship at

Prague will be to finalize these conclusions

matter for discussion will be the fearibility

11.10 Downward Penetration of Solar

and arrange for their publication. A second

components. Tentative conclusions and rec-

ommendations will have been discussed at the

Kyolo MAP Symposium in Navember 1984.

Croup on Solar-Terrestrial Relationships 11.9 Tides in the Middle Atmosphere Sponsor: ICMUA (IAMAP), Working Croup on Tides in the Mesosphere and Low-

Cosponsors: SCOSTEP, COSPAR, WMO to be confirmed Cochainnen; A. D. Belmont (USA), A. Ebel IAMAP Officers

The aim of the workshop is to contribute to a better understanding of solar induced changes in the aunosphere through presentations restricted to less controversial topics in the field of solar-terrestrial relationships. Therefore, it is intended to concentrate main ly on effects observed and/or mndeled at middle stratosphere heights and above. Contributions about radiation and particle effects, response mechanisms, solar activity data etc.,

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Cochairmen: Lorenz C. Magaard, Depan-ment of Oceanography, 1000 Pope Road, Honnlulu, 111 96822 and Colin S. Ramage, Department of Meteorology, University of Hawaii, 2525 Correa Road, Hondulu, HI 66822; Members, Charles Helsley, Dennis Moore, James C. Sadler, Charles M. Fuller-

#### Citation

Mr. President, fellow mendiers of the American Geophysical Union, and members of the U.S. Navy, it gives me great pleasure to present the citation for the 1984 ACCV • Join AQU and receive Eos every week for the rest of 1984 at no additional charge. Dr. Navier Le Pichon. USN Morrice Ewing Medal, to be awarded to

After receiving diplomar in several disci-plines of geology, physics, and geophysics from the University of Strasbourg during the 1950's, Navier came to the Lamout-Doherty Geological Observatory as a visiting scientist where he put his knowledge to practice muit 1968. In 1966 he received the Docum at Sciences degree from the University of Strasbourg, Remissing to France in 1968, Navior snem the next five years at the Centre Oréanologique de Bretagne in Brest where REGULAR MEMBERS-individuals who are professionally angaged in or associated with geophysics including college or university students. Students be founded the Research Group, From Brest incolled in at least a helf-time program of study isading to a degree receive reacted reduced dues and journel subscription rates. ASSOCIATES—individuals not he mored to the headquarters of CNFSO in Paris for 5 years and then to the University of Paris to found the new Laboratorie de-Geodynamique. From his present position of professor at the university he will move next vear to become director of the feedogy Laboratory in the Ecole Normale Superience, one of the French Grandes Ecoles.

There are many examples of Navier's scientibe accomplishments, and they occupy a very broad sectrum of the marme science disciplines. Author or reanther of three books and some 150 other publications, he has been a most prolific producer of experimental and observational results and of new ideas. Among his contribution that I am most familiar with me reveral papers based on his work at Lamont covering a wide range of sunlies in seismic, gravity, magnetic, and genthermal methods. During this period he was also a major collaborator in establishing the validity of the place technoics story, countbring sevcral of the key early papers and producing the list global map of plate boundaries and motion. At the same time he was engaged in a major effort in which he combined physical oceanographic observations and seismic reflection surveys into a coherem picture of bottom water circulation and its large influences on the regional sedimentation patterns of the South Atlantic.

Navier's continuing interest in the plate tec-tonics theme has resulted in a large number of significant contributions in the refinement of the global tectonic framework. He has shed considerable light on the tectonic devel-opment and evolution of rifted continental margins, within a framework of extension, fracture zones, thermal subsidence and sedimentation, and he has been engaged in a monumental study and gendynamic interpre-tation of the Aegean-Hellenic Arc region of the Mediterranean Sea. A recent addition to his already varied collection of publications, in which he probes more deeply into the earth, is genid, paugea and convection. Another important area of marine research in which Xavier's participation and influence were primilinent factors has been the initlation, with Woods Hole, of Project FAMOUS and follow-on promotion of deep submersible milization in a variety of stodies of the seafloor. A major program to study the Japanese trenches is selectuled to begin next year with the new French 6000 in submarine.

This very brief listing of some of Xavier's work is not intended as a sunmary but, rather, as an indication of the breadth of his endeavor in pursuit of a better understanding of the earth. The topics of his publicutions range from ocean circulation to processes in

AQU (cont. on p. 700)

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MAJOR SECTION AFFILIATION

and value of developing an observationally-based climatological model of tidal winds and temperatures in the mesosphere and lower

Activity Effects into the Middle Atmo-Sponsor: ICMUA (IAMAP), Working

tochem, Modeling 8.2 Solar-Terrestrial Forcing of the Middle Atmosphere B.3 High-Lainude Phenomena B.4 Short-Lived Species in the Middle

8.6 Nocillacent Clouds, including Re-

8.7 Interaction of Neutral and Ionized Components of the Midrile Atmosphere

Convenor: R. G. Roper (USA) (not yet con-

The sessions of Symposium 11 are devoted will be momentum and heat transport due to tary waves) as well as turbulence (2- and 3-di-

11.1 Progress in Remote Sensing Tech-niques from the Granted and from Satel-

cluding Troposphere Coupling
11.3 Dynamics of the Mesosphere and

11.5 Tides, Gravity Waves and Turbu-

11.7 Coupling between Photochemistry

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Inter-Union Commission on the Lithosphere

IAMAP Commission on Polar Meleurology

International Association of Ceonagnetism and Aeronomy
IAHS
International Association of Hydrological Sciences
International Association of Meteorology and Atmospheric Physics
IAPSO
International Association for the Physical Sciences of the Ocean
IAVORT
International Association of Welconology and Chemistry of the Earl

MAS Middle Atmosphere Sciences
SCOSTEP Scientific Committee on Solar Terrestriol Physics URSI Union Radio Scientique International Venus International Reference Atmosphere

the mantle, from evaporites in the Mediterranean and under continental margins to tec-tonics of back are basins, from subsidence of margins and continental basins to techniques of seismic analysis, from stretching of the hthosphere to avalanching in submainte cauyons, from seismic stratigraphy to pales or rotation and continental recruist maints. from fracture runes in mid acean to the Pyrenees. From seamounts to deen sea trenches, from sediment distribution to analysis of gravity, magnetics and geother mal aumnalies. In very few of these topics have his contribu-tions gone unnuticed. Some have been controversial; a few would probably have been written differently if he had had acress to a crystal hall or to hindsight, but it is far more important that he consistently looked for answers to non-trivial questions. In doing so he covered a lot of territory and he has had a great impact on many important areas of marine science during the past two decades. In addition to his own work, he has guided and influenced the research of many of the younger generation of French scientists and has also played a prominent part in developing scientific policy and priorities both at home and abroad. He has served the scien-

al and international committees, in which rule he is extremely effective by virtue of his scientific provess, a keen and organized mind, and strong metivation. So, Xavier, it has been a long and productive time for you since the 16th cruise of Vena when, I believe, you began in carnest to get your feet wer, both literally and lightthely, in marine geology and geophysics, You learned quickly, you worked hard and you accomplished much as a scientist and as a sci-

tific community on a large number of nation-

entlic stateman. We salute you for your past arhievements, and we fully expect that you will reward us with many encores in the In-

#### Eric L. Butler: Congressional Science Fellow

Eric L. Butler, a chemistry and oreanog-raphy instructor at Phillips Arademy in Andover, Mass., has been se-Ircted as the 1984-85 AGU Congressional Science Fellow, Last week he began his 1-year stint

on Capitol Hill as AGU's eighth Congressinnal Science Fellow. Butler, a member of AGU's Ocean Sciences section, rereived his Ph.D. from the Graduate School of Occasing apply of the University of Rhode Island, While his formal course work focused on chemistry and oceanography, his research has ilealt largely with atmuspheric chemistry and the measurement and geochemistry of trace organic compounds. He has been associated with the Center for Atmospheric Chemical Studies at the University

From 1978 to 1983, at URL lie was coprincipal investigator of a National Science Foundation-sponsored grant on methyl jodide and the amuspheric iodine cycle. In recent years he has designed and implemented a system for the collection and quantitative analysis of methyl iodide using rapillary gas chromatography. In 1982, Butler combirted atmospheric sampling research on a cruise in the Perurian upwelling area and no light expeditions to Oahn and Manna Loa. While at URI, he was an necanography in-

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August 1864

of Rhode Island since its inception several

structor and a graduate research assistant. Last September he began teaching at Phillips Academy to broaden his teaching experience. Many of the topics that require "congressional concero and action" often "cut across

the traditional boundaries of the various scientific disciplines and call for an interdisciplinary perspective," according to Butler. He hopes to apply his interdisciplinary approach to oceanography to his work as a Congressional Science Fellow. Butler received his B.S. in chemistry, mag-na cum laude, in 1976 from Muhlenberg Col-

lege in Allentown, Pa. The AGU Congressional Science Fellow program is one of about 20 professional soci-

ely programs that make up the American Assuciation for the Atlyantement of Science (AAAS) Congressional Science and Engineering Fellows program. This program involves scientists and engineers in making public policy within Congress through work on mem-bers' staffs, on congressional committee staffs. or in some other area of Congress.-BTR

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#### Acceptance

May 1

Twenty lire years ago, mader a Fullbright fellowship, I joined Lamont-Doherty Geological Observatory to specialize in marine geophysics. The lirst day I met Mantice Ening, he told me, "Get ou the Vena, she is sailing next week. We need a physical occamignapher there." I quickly understoud that this was not open to discussion. And this is how I joined the 16th croise of Venn around the world, measuring potential temperatures to trace the path of the deep Indian Ocean Water. But it was during this ernise that the continuity of the mid-ocean ridge around the tip of Africa was tested. We were criss-crossing the rift-valley and had to wire back to Doc Ewing in Lamoin each time we found the erack at its predicted location. Such was the beginning of my love affair with the Mid-Ocean Ridge which kept me insisting that I wanted to do marine geophysics, not physical oceanography. It was also the beginning of my education to research.

Today is a great opportuoity for me to say how grateful I am for these six years at Lamont. How much I learned there about science and about life, especially from Maurice Eving, John Ewing and Manik Talwani, bot also from Marcus Langueth, Jim Heinzler, Bruce Heezeo and many others. This was a time of great scientific opportunities in an intensely living laboratory. I also realize how much I owe to the American research contmuoity and its exhilarating high pace of competitive opportunities. I most single on Har-TV Hess outside of Lamont as one of those who inspired me most.

John Ewing knows how difficult it was for me to elecide to go back to France in early 1968, at a time where the plate tectoric revolution was spreading over the whole states. Maurice Ewing could not understand my decision: "Why go back to such an old comtry?" He told me, "If I were in your position, I would go to Australia". But mao ha a heart and, formmarely, love of his nwn country is deeply imprinted on it. Later on, I was impressed by the fact that Duc himself decided to have his last research venume in Texas, his quotre Back in France I had to cover through years of struggle that, although science is the same there, research life is quite different from the American one, different and hea sense complementary. Through the last 15 years, I have seen Europears genscience grow and mature. It seems to me that it is now quite healthy and hithbling with life, emerging as a real partner to American geology and I hope that this Mau-rice Ewing Medal presentation will be another link between American and European gensciences. Finally, it gives me great pleasure that this presentation is made by John Ewing who taught me the basics of marine seismole gy and assuted me of his continuing friendship and patient understanding during the 5 vears I spent ju Isls team. Thank you, John.

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Budspart, Fun Bula tor 2, Sungary)
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solution of the electrical direct problem for such a case is vary complicated.

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AN MALIAIS OF THE INPLHENCE OF FRACTURE SCORETY ON MASS TRANSPORT IN FRACTUREN MENIA
Levius Stitch Lept. Geological Sciences, University of Exities Columbia, Vencouver, Casada, VOT 284),
P.W. Schweltz
A tracharic modaling technique has been developed to bayestigate mass transport within a astwork of district Fractures. The Fracture network is composed two orthogonal Tractures meral with fracture length, location, and aperture theretweeld the option of two orthogonal Tractures meral with fracture length, location, and aperture theretweeld by sepicoprists probability distributions. Emphasis is placed on undorstanding how fracture geococry distentiousum Fractures. The network is aligned in achieves a memor that one Fracture set [set one] lorum the deal many that one Fracture set [set one] lorum achieves between the discontinuous Fractures of set the second fracture may for transport within a network of the memor that the second fracture rate for the directness of the tomostion between the discontinuous Fractures of set tomostion between the discontinuous Fractures of the tomostion between the fracture geometry which the offset of increasing the probability that a telephony than network gees taily lead to no Beressee in the optical as reduction between and standard deviation is really in the set of the two probability factor of circultode pothesy exists but she was and standard deviation is really and active through in the probability factor of decrease in the probability factor of decrease in the probability factor of the sensitive to the vericality in fracture growers, the connectivity of the Fracture getwork fracture abover to influence the sugnification of dispersion and colored to influence the sugnification of decrease. The connectivity of the Fracture getwork fracture abover to influence the sugnification of dispersion also above to influence the sugnification of dispersion and to above to influence the sugnification of dispersion and the probability in fracture probability in the connectivity of the Fractur

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A 199EL FOR JAVESTISATING MECHANICAL TRANSPORT IN
FRACLUPE FLOW NE TWORKS
H. A. Endo (Earth Sciences Division, Charactee Berkaley
Laboratory, University of California, Berteley, Ca.
947201 J. C. S. Long, C. P. Milson and P. A. Mitherspoon
A techniqua is presented to determine whose unisotropic
fracture systems com be radeled as equivalent porous
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easumptions far some fracture systems, life ap norous realum
easumptions far

Water Sesour. Ros., Paper 490818.

State Inc. whirecord constructed for ignition tests at the description was a second se

reguland is substantial improveduals in simulated reservoir operating policies. While these results are for a dar at Assen to the Nile River East, operators of other reservoir systems also have available to the toformation other hims the proveding period's indica which can be used to develop (agreed inflow forecasts, iRmservoirs, optimization, stothasfir processes, Asmen Pan).

Wager Resout. Res., Paper 497933.

3199 Georral Hydrology (Geothermal Reservoir Regineering)
THE STAPLA GEOTHERMAL FIELD, ICELAFO: ). THE GRAEFATING
CAPACITY OF THE FIELD
6, 8. Sedvarsaon (Sarch Sciences Civision, Levrence
Barksley Laboratory, University of California, Sarksley,
California, 94719), 8. Proces, V. Stafangson, and S. T.

THE REAPLA GOVERNMAL FIRLD, ICELARY: J. THE WARRANTED CAPACITY OF THE PRIAD C. B. Bodvareson fileren Briench Overland, but the property of the generating capacity of the state of the sufficient of the system. The model is sprided to the old multilaid the system. The model is applied to the old multilaid at Brailing from the property of the Brailing Plaid are also performed wileged that the system. The model is applied to the old multilaid at Brailing Plaid are also performed wileged the training property of the Brailing Plaid are also performed wileged the training property of the Brailing Plaid are also performed wileged that the property of the Brailing Plaid are also performed wileged the options reservely regions at Kreil are developed and their generating capacities for the warlows reservely regions at Kreil are developed and their generating capacities for the warlows reservely regions at Kreil are developed and their generating capacities for the warlows reservely regions at Kreil are developed and their generating capacities for the warlows reservely regions at Kreil are developed and their generating capacities for the warlows reservely regions at Kreil are developed and the property of the state of the areas and trough. We have resulted obtained light does the the old multifield the second of the property of the proper

Vater Resour, Res. | Paper W1042.

1199 General Hydrology tGoothermal Reservoir Engineering THE ERAFLA GEOTHERMAI FIELD, ICELAND: 2. THE NAIURAL THE MARIA GEOINGRAM FIRE THE TANK THE STATE OF HE STATEM G. 3. Bodygragon [Earth & Lences Division, Coursence Industrial Office of California, Orre-

California, va(20], E. Praess, V. Stalansson, and t. T. Ellasson.

A model of the natural state of the Kralls reservoir system in iculand has been developed. The model complete of a vertical cross section that includes reservoirs in both old and new well (telds. The physical processes considered include mass transport, conductive and convective best framsfer and botting, and condengation. Hatural heat losses to surface manifestations [aprings] are also included. The model matches very well all relevant data from the frafia lield. The natural (low of hot (luids through the reservoirs is estimated at approximately 20 kg/s. Items escaping to surface springs constitutes the bull of the heat losses in the area modeled. Conductive heat losses through the tesprock are approximately if Wiscondings of the heat losses in the area modeled. Conductive heat losses through the tesprock are approximately if Wiscondings, groundwater, thermal properties).

Water Sesour, Son., Paper 441041.

#### Oceanography

4113 Circulation
VRAHICAL STRUCTURE OF THE ZONAL PRESSUM CRADIENT IN
THE EASTER 19UATORIAL PACIFIC
I. J. Sangum and S. P. Mayes (Pacific Martine Environmental Laboratory/KMAA, 7aPo Sand Puter May MY.
Seattle, Mashington, 981157
CTO data from the \$PCCS and KORPAX experiments were
used to construct a mean zunal pressure gradient
profile between 110°W and 150°W for the 1979 to 1981
profile Nike Interpreted. The mean zonal pressure
gradient referenced to 1000 db land a value of -4.5.
10 ° m s 4 at the surfare and decreased to within two
standard errors of zero at 200 db Below this depth,
the mean was not significantly different from zero.
Deviations from this mean were not related to fluctuations of the zonality averaged zonal wind stress between
10°W and 110°W. Rather, the largest deviations, in
horeal spring of 1949 and 1880, supeared to be associated with first vertical mode kelvin wave pulses propamating sastward along the equation.

The 1919-81 mean profile was also used as a reference
to reassine variations in zonal pressure gradient during
the 1982/85 FARSO event. The sea surface was more
sharply sloped upward from cust to west in April and
Sopticaber 1982, before and near the beginning of the
event. The surface slope was below moreal in April and
October 1981. Fertical profiles of the zonal pressure
eraduml deviations showed larger high vertical mode
contributions during the event than in the pre-event
amples. (Equatorial pressure gradient, El Miño.
Kelvin Vaves)

J. Geophys. Ros., C. Paper 461036.

4760 Igos Igos
THE SERGITIVITY OF A ORZ-DIRENSIGNAL THERMODERARIC PER
IGE PROPEL TO CHANGES IN CLOUDINESS
5. P. Shiths isopartment of Atmospheric Physics, Clarisation
Latoratory, Onford ORI Yall, U.I. I and 8.6. Grame
A thermodynamic see icolicover changes to modelled low
the importance of cloud cover changes to modelled low
thickness. for regions of either jurnament multi-pror
ice or seasonal sea ice. the cloud abunt variation have
relatively little impact. Bowers, for regions where the
presence of support lookers, for regions where the
predicted ice thickness is strongly deperient on citcul
cover. In general, with a since covered serface, decreapredicted for thickness is strongly deperient on citical cower. In general, with a smo bevoid surface, decreased cloud leafs to surface coding while increased chief gives ruse to a surface warning. For a critical tare two surfaces, the isocade response tice is too long for intermedial variations in filed secund to sapials interapred variations in its thickness sad action. Revertheless, the implication of the results is that numerical modelling of sea too distribution requires accurate cloud data or cloud prediction, and that trains in cloud cover at least or infiliate porturing fore it.

J. Geophys. Ses., C. Paper 4C1003.

4760 Som loo A COUPLED IGE-OGRAM MODEL OF IGE GREAK-UP AND GAMDING IN THE MARGINAL IGE ZONE a COUPLED IGE-OGRAP RODEL OF ICE STEAK-UP AND BARDING IN THE FARDINAL ICE ZONE O.K. Smadated | University of Cato, Institute of Geophysics, F.C.Sox 1022, Silndorn, N-Osio 3, Sorway) and L.P. Smad A coupled tos-commanderies model for the marginal toe same (a someidered. The model commander of a confiner see los model and a two layer (roduced gravity) came model. The dependence of the upwelling response on with a troes direction (a discussed. The results confirm earlier smallylice) work. It is shown that theme exist directions for which theme is no upwelling. While other directions give maximum upwelling in terms of the values of uptified ester. The ice sed scoop is coupled directly through the stmess at the interfered to some a. As interesting occasionates of the coupling le found in cases when the loc edge is simple to seek up a few Aceths of hilometers inside of the ton edge. [See los, ton adgo upwelling, too break-up).

J. Geophys. Res., C, Paper 408990

anolytical rode 1).

Butlabilit of the Wind Lave Spectrum in Pinite Cleft Water 1 - Spectral rode 1 | Mar-Pianch-Institut |
For Natocologies, Bundasett. Si - Gentallist, D-2000 |
Bamburg 11, Pederel Rapobile of Cermany and G.L. Vincant A selfalmiler apactral shape (the TW-spectrum) to describe windowes to water of floid dependent and an extension of the deep water 1008SMP-spectrum. The behaviour of the spectrum to Exequency and wave number apace to discussed. Shout 2000 spectra selected from the three date sets INZEGL around, MARSUR, ARSURY are investigated to show the general validity of the proposed selfalmiler spectral shape.

ANOCIATE VITE INTERFALENCE SECONS BLOCKS BL

J. Coophys. Ros., C. Papes 4C1001

ATOS
A THREE-PIRESSIONAL ANALYDIS OF MARINE RADAS IMAGES FOR THE DETERMINATION OF OCEAR MAVE DARRYTICALITY AND SURPACE CHREFTS
I.S. Young, M. Bossanths! (Max-Planch-Institut for Metao-rologia, Bundomatt. SS - GEOWATTEUM, 2000 Remburg II, Federel Ropuble of Ceremy), and F. Ziener
A time series of Photographs from the radac screen at a conventional marine radar 10 sonlysed to determine the three-dimensional S(hg, hg, u) spectrum. Significant spectral assray density is found only to the close vicinity of a shall in k, we spect delined by the disparation relation. Sidece corrects influence the disparation relations that shaperion relation that spectrum and the second series of the second series of the second series of the second series and shall be second series of the result wave given. Two-dimensional, three-dimensional wave spactre).

J. Coophys. Res., C. Paper ICIOOS

J. Geophys. Res., C, Papes 100961

#### **AGU** Congressional Science Fellowship

The individual selected will spend a year (September to August) on the staff of a congressional committee or a House or Senate member, advising on a wide range of scientific issues as they pertain to public policy questions.

Prospective applicants should have a broad background in science and be articulate, literate, flexible, and able to work well with people from tliverse professional hackgrounds. Prior experience in public policy is not necessary, although such experience and/or a demonstrable interest in applying science to the solution of public problems is desirable.

The fellowship carries with it a stipend of up to \$28,000, plus travel allowance.

Interested candidates should submit a letter of intent, a curriculum vitae, and three letters of recommendation to AGLi. For further (letails, write Member Programs Division, American Geophysical Union, 2000 Florida Avenue, N.W., Washington, D.C. 20009 or telephone 462-6903 or 800-424-2488 outside the Washington, D.C., area.

Deadline: April 1, 1985

4749 General (Coastal Dynamics) LOCAL WIND FORCING OF A COASTAL SEA AT SUB-THERTIAN FREQUENCIES

J. N. Lewis (Science Applications, Inc., 2902 Lodgepole, College Station, To 17840) and Robert G. Beld An analytical, normal rode, two-layer node: 13
An analytical, normal rode, two-layer node: 13
Pratentad whith gives the response of a toastal region
to [occl wind forcing. The model is linear and is
demeloged in frequency tyace, the latter filearing one
is compare the model responses directly with the
results of current reter/wind dele specifies and
coherents analyses. The Incommental development
indicated the caquirement of a frictianal parameter in
obih the benowing to and benocl infor codes to believe
the wind strong as lower frequencies. Experimentation
with the model and current and wind dets collected 20
be off the Teres codes showed the requirement for both
frictional olifacts incomphost. The aub-inertial
frequency renge.

fricitenal elfects incomphose the aub-inertial frequency renge.

Mith appropriate frictional percretars, the modal predicts the response of the Texes restal region to lacel wind lescing quits well ucing dair from the fail and winter of 1978-1979. However, during the surver of 1978, the model consistently under-predicted the energy levels of Abb currents. Sinte the summer is a period of low wind stress energy for the leads shelf, this under-prediction cost libely indicases Abe presence of mon-locality-generated their wave phenoment. (Altrace interaction, reasted dyesoics, analytical reds).

HIGO Shock waves
CARRCTERITICS OF SERVETTC PAPTICLE EVENTS
ANIOCIATED WITH INTERFLANDARY SECONS
5.-F. Wennel (Space Stlence Dep., SEIEC, 2200, AC
Soordwijh, The Netherlands), S. Reinbare, T.e.
Sanderon and E.T. Harris.
We present observations us the 15-1600 keV proton
intensity-time profiles and the 15-1600 keV proton
intensity-time profiles and the shree-discontional )S56 beV asisotropy distributions recorded during two
interplanetary shoch events on 188E-5, and discuss
these in the light of current particle acceleration
models. The large 5 entil 1914 cames rescaled with interplanetary shoch events on 1885-5, and discuss these in the 1(ght of current particle acceleration models. The large 5 spill 1919 amor associaced with a quasi-perailed shock shome an extended foreshoch region with a utrong lucrease of the upstream protocolius, a doumetreem plateau-lishe grollie, a patream flot of the shock and downetreem Instruy in the solar wind (reme all reference. The small 9 March 1972 event has a structured laremeity-less profits, a narrow shock replas and anirotropit angular distributions both up- and downetreem, the anisotropies insedistally behind she shock ashibiting an intensity peah of plich angles around 90°. The April event representative for a class of large footgets from Particle 1887; event shows many observational instrume whith are in agreement with predictions made by diffusive aboth straighteet with predictions made by diffusive aboth straighteet with predictions made by the fusive aboth arealaration models. The March amont representative for a rises of avacts with transplar positive and whight acceleration. We concluded that both acceleration models are operative the association with laters and straighteets and straighteets and states are presented in the second acceleration models are operative the association with laters and states are presented as the second acceleration models are operative the association with laters and states are presented as the second acceleration models are operative the association with

5340 Shock Wares MODIFICATION TO MHOCE FITTING PROGRAM M. H. Adunt Flemstery Hagnetoepheres Branch, 889A-Goddard Space Flight Conter, Greenhalt, Maryland 20771) and S. P.

Space Flight Center, urgeness, assistant sping A modified form of the impring-Argentiero eSogle A modified form of the impring-Argentiero eSogle apenmorat, shock normal delarmination procedure le prasentad. The modified melbed innorporates a elup predictor-corragior elegation which allows a Panhar nonvergeam rais and the was of svarage values of a parameters for the atarting master. Esheck normal teahnSquee, acter wind plasme, magerico fieldal.

J. Coophia. Ses., A. Paper 4A8159.

# Chapman Conference

## Solar Wind-Magnetosphere Coupling

Convenors: Y. Kamide and J. A. Slavin

February 12-15, 1984

#### Jet Propulsion Laboratory, California Institute of Technology

The purpose of the confirence is to tocue ettention on the solar wind-magnetosphere coupling problem, to provide a timely forum for the exchange of ideae, and to promote intardisciplinery colleboretion between the various solar terrestrial invastigators.

The topics to be addressed by the contarence will include: stetistical enelyses in solar terrestrial physics, geomegnetic indices and their predictors, response of magnetospharic boundaries, current eystems, and plasmas to interplanetary conditions, theoretical/experimental coupling functions, and applications of numerical simulation theory.

Program Committee: D. N. Baker, Los Alsmos Nationel Laboretory, S. W. H. Cowley, Imperial Coltage; D. A. Hardy, Air Force Geophysical Laboratory; Y. Kamide, Kyoto Sangyo University; J. H. King, NASA/Godderd Space Flight Center; L. Lse, University of Alsaka; R. L. McPherron, University of California, Loe Angeles; G. Rostoker, University of Alberts; G. L. Siscoe University of California, Loe Angeles; J. A. Slavin, JPL. Celtech.

Information circulars regarding this conference may be obtained by writing to Solar Wind Coupling Meeting, AGU, 2000 Florida Avenue, N.W., Washington, D.C. 20009.

Abstract Deadtine: November 1, 1984

534P Short Waves
THE SECOND GROUP INECAN OF ELECTROMAGNETIC
NOT TOR BEAM INSTABILITIES
5.P. Gary ISPACE PINNES Physica, E55-8, for
Alaros Matienet Laboratory, ion Ainvol, Ma
87515) and Rat. Towar
The heve-particle interactions of a hot ion
beam streaming along a magnetic field B are
studied. A tecond-order theory of electroranguatic instabilities in a homogenous, tallisionlass plasma at propagation parallel to
B is used. The law instabilitials most likely
to Pe driven by a hot bean are thu vight hand
and left mad rusonant ion pasam instabillities. If the conditions necessary for the
vilidity of the Theory are met, the test model are found to relaferce one another. That is,
each mode acts to produce a bear missorrapy
which reduces the sum prowth rate, but tohancer the growth rate of the other. Thus
this theory predicts that, whenever sufficiently hat are diffuse "loss are found at a
tailistories; thock and the plasma is suffitiently hattagenous that stypificant cave
growth is possible, for test instabilities
will bet by produce a misure of both right
and foil had polarized Mighlie waves.

J. Growbet, Occ., t. Paper shall?

J. Gruphys. Sce., t, Paper 458124

Size Solar wind planes
TENFORAL EVELUTION OF THE SOLAR WIND ARP THE FORMATION
OF ESTABBLING SECS
STAGIS A. Better thereard-Saithaedian Center for
interphysics, to Gardee Si., Cambridge, Pt O213bi,
Fobert Energer
The temporal evolution of the solar wind from one
steady stale to another is explored when momentum
dypolition produces outlibe with the solar in the
flow. We show that the wind always avalues in the
flow. We show that his wind always avalues in the in
a new sleedy stale accompatible with the solution of ihe
sleady state squation of motion. However, for the same
intiel state and identical asymptotic momentum
deposition rate, the temporal swolution pattern of the
wind depends on the detailed limb history of gramation
eddition, and is therefore out unique. This feature
plays as ingurent role in the partitudir case whos
writiple three in this sludy) stoody steks enter for
identices tourdary conditions; such one of these
solutions is thus shown to be physically soccemble.
The details of the temporal swolution pattern of the
eind vevent the torgation of a check discontinuity

#### Particles and Fields— Ionosphere

5510 turoval game dagasetic vifects COMPUTED MidwalfilumE MAYETIC FEELOS M. Sen (Goophylloul Imatlessa, Univocalty of Siasts, Fmirhamba, Elacon, 391011, 8,-4. Ahm, 5.-1. Atacofu and Y. Knalda Hagnotic dinturbanno iloida fa thu diddle letiiude rispostic dinterbanno Holdn is the oldito letitudo are to-beted at 5-misuto intervate for inch il, is and is, ters from the distribution of the high lutitude lumpharic currents, which was determined from the lis lis maridian costed as a responsive through a numerical sadding nothed. Each high latitude myrent sagaont in accrete to be connected to the deposit and demand if fold-mispond turrents ulting the dipolo Held issue and a closers through it is shown that a significant port of the widdle factioned magnotin disturbance Helds tend by reproducted by the finish of such Larce-dimensional current systems. In surroutant with certific significant that is the individual of such Larce-dimensional current systems. In surroutant also that they is genyral, the largest contribution to both the Hend Components in the middle its that the signetic fields are disturbed in detail.

J. Geophys. Sen., A, Papev SAIDII.

S535 interestings Decayson Wives and Partists
THE L-SHELL SPOKEN OF THEOREMSET FOR UNIES EXITTED AT
GROUND-LEVEL AS A LOSS RECHANISH FOR TRAFFOR ELECTRONS >
SPATIAL CORRELATION OF THE IONOSPHERIO TOTAL
ELECTRON CONTENT AT THE EQUATORIAL ANDMALY Inhof (lockhaed Pale Alto Research Laboratory, Alto, Calitornia 983047, J. C. Reseat, E. E. tion of this paper is to identify the L-sheli

electrons with courgine spore b8 keV. This assumment is made possible by studying the dey-night differences in inner built distron precipitation and comparing with the known stronger transplence at waves through the locumphers at night and the hnown higher doycles intensities for vevos of satural origin other than then lightings, incensities of observant intensities of affects in the state of observant intensities of affects in the state of the state of the state of observant intensities of observant intensities, in 1979 the liner reduction bed is a hown to buse had the foliawing unique features for electrons > 58 keV: 11 the rates of procipitation from the radiation beits at longitudes went of 140°E were significantly greater near oldelight than may sountine for t = fi.b - 2.21 21 at the longitude went of 140°E were significantly greater near oldelight than may sountine rate of injection showed little termination with the procipitation on other L shalls in contrast that the dayfrae pracipitation is which a nightlicent correlation exists at injection showed little termination that the range t = 1.2 - 5.P. From those reptries! findings one seculates that is the hourt of the inner radiation but lightning endfor transmitter generated summ emitted from ground level prochely played a significant rate in precipitating electrons > 58 keV at highttime. Below the region term much less pronounced, indicating that VLY waves entitled at around-level very out the less promounced, indicating that the mean, VLY waves, lightning).

S COOKDULITED SATELLITY AND GROUNDRASTO STUDY OF AN INTERES ELECTRON PRECEPTIATION REIKE OVER THE ROUTHERN FOLAR CAP W. S. INDER SECTION OF THE ROUTHERN FOLAR CAP W. S. INDER SECTION OF THE PROPERTY, PRIOR

W. t. Imbaf [Lorkhend Falo tilo Genverch Leboratory, Falo Alto, Calliarals \$4304), T. J. Rosseberg, t. J. Battows, J. Lanswordt, J. G. Bengan, H. O. Yoss, D. U. Dattows, J. G. Sitcher, G. E. Galmes, J. Mobilia, end G. D. Joiner An alectron previpitation swant has buse investigated With bressstrahlung x-ray supping dass taken from two satellices and with groundbared rissater and vegestnesty data. The awant necurred year 2300 UT on \$J June 1952 in Che wieloiry of Bouth Fole Station which was in the dusk-widnight local time settor. The esin precipitation was essentiated with a polswari-moving westward electrojet and product the iargest riosster absorption [exceeding in the 47 10 Majn seconded Suring 1952 at that station. The feature stamped in detail here is an incense uplie of 10 seconds duration and limited special matent that occurred as a shortlived server journaberic curvent occurred as a shottlived serverd longapheric curvent developed squetorward of the vestward electrolet. At the developed squatorvard of the vestward electrojet. At the view of the spite, red anosters as the 778-1 sate illts measured easestality significances from the region viewed by the ground-based instruments. However of the spite, red anosters as the 778-1 sate illts region viewed by the ground-based instruments. However of the spite presipitation region a covered the pole was indicated by the vestored and the red of th

J. Geophym. 44m., t, Yapet 4A8085

356] Plasma motion, conveytice, or circulation THE PRASUREU MOTIONS INSIGS EQUATORIAL PLASMA STROLLS W. S. Hannou (Center for Sps. Sci., Physics Program, Daive of Taxas-Delian, Sichardson, TX 730831 and O. A.

W. S. Hannou Commer for Spe. aci., Physics Program, Daire of Tassa-Delian, Sichatdon, TX 7503; and S. A. Bangboys

1 preliminary study of the vertical sod notth-south borisouth do mations in plasma hubbles in the near equatorial lossythms in plasma hubbles in the near equatorial lossythms to restand high resolution data show ther the vertical to velocity in some bubbles increases approximately limiting the No. N./U. where N. 10 the berkground for concentration and N is the bubble ion conventration to tenfliciently large 80/N the vertical ion velocity saturates, but often at a value substantially larget than the tation of the gravitational acceleration to the ton sautical vollision trequency 41/vg.1, which is the modinal collision dominated velocity light for cylindrical bubbles. These larget than nodest velocities say result from buct-ground emisved velocities and only from a vertically elongated bubble cross sattled. The unantivipated observation that large than nodest velocities on forms it delta acceptant that a redistribution of plasma along lisk tubes as the plasms conveyts from the bottomide of the Y region to bigh sittudes.

3. Coophys. Eas., A, Proper Addyli

CREST Ylan-Nien Husni (Telecommunication Laborato-rles, M.O.C., P. O. Sox 71, Chung-Li, Taiwan, Republic of China)
The spatial correlation of the ismospheris.
The spatial correlation of the ismospheris.
total electron content at the squetorial eng-

J. Couples. Rasi, A. Popes Assets

for a given sidered time intervel is taken to be the aignal level corresponding to the injection polar on the high-signel side of the peah of the distribution of the second country of the second country of the second country of the peah of the distribution of the second country is able the errice without of calculating the QIC and the superiority of the greats sethed is demonstrated. This method has been applied to the Nik riconter data from Miply station, Antactical [72 lb's, 8] 10-14 for 1975 and 1980. Caspite the presence of high levels of propagated interlatence duting some worths in 1980, the technique is able to generate smaths in 1980, the technique is able to generate smaths in 1980, the technique is able to be about 0.1 48 when interference is present, but much lower at other time. Changes in the Ct levels from count to conth have been found which are qualifatively consistent with expected smanonal lime, solar tentity and is affects. The technique described here provides an objective spectational delimition of the QCC which is relatively assy to edopt to compute calculation and response to be a presiding should for the detection and radiovave absorption by the innosphere. Planeter, innosphere radiovave absorption.

#### Particles and Fields— Magnetosphere

5745 Hagnetoepheric configuration THE EFFECTS OF DEPOLE TELT OF THE STRUCTURE OF THE THE EFFECIS OF DEPOLE TELT OF THE STRUCTURE OF THE MAGNETOSPHERE
C. C. We Department of Physics, University of California, ton Angeles, California 2002a;
The structure of the magnetaephere as a function of dipplis tilf was studied by using a global MMD model. We show here that the cusp ruvrant should in the MMD model is calculated to the tail current sheet and that the calculated shape and positions of the tail current sheet are consistent with observations. In addition, so discuss the difference beingen the MMD model and the Chapman-Farraro type madel which manifests as a function of tilt engls. Illagnotosphere, dipple filt, currents f.

J. Geophym. Ram., 4, Paper AA6946

5755 Plasma instabilities
RELATIVISIC DISPERSION, ITE CYCLOTRON MASER
INSTABILITY, AND AURORAL KILOMETRIC RADIATION
P. t. Pritchest iDepartment of Physics, University of
California, Los Angeles, California 9002al
The most successful amplanation proposed for the
generalion of successful amplanation and the continuence of the cycloform frequency is casential to
distance of the cycloform frequency is casential to
distance of the cycloform frequency is casential to
effects can also significantly modify the mave disperalicy, even for unity middly relativistic classification, even for unity middly relativistic class in the A03
source region. For a relativistic Hawwellian distribution the then apple on the frongit of the satified below
the for integers of 1/311 https://doi.or. kinear analysis of d
della-function ring distribution in principles that
the A-A mode is unstable for he is allicates that
the A-A mode is unstable for he is allicates that
the A-A mode is unstable for he is allicated below
perpandicular in the adaptette flying with the Bo is fall
the A-A mode is unstable for he is allicated to
perpandicular in the adaptette flying with the course for
he/for all is minor for he is united with the is in the
he-A mode is unstable for the propagation and
perpandicular in the adaptette flying with the course for
he is a fall to the propagation and the is a fall to the propagation and for its and the formation of the integer of the propagation and the integer of the angle. The
normal propagation and the redaining the he is a model to the propagation and
the addition of normal electron companient products a
normal propagation and particle color in the propagatio J. Goophyn. Ros., A. Paper 4A0917

Journal of Geophysical Research

Volume 89 Number CO Septembet 20, 1984

An Estimate of the Upwelling Rats in the Equatorial Atlantic Based on the Histilburion of Homb Rodlocarbon and Quast-Geostrophic Oynamics (Panet 4C0713)

maly creei was scudies by recording Fareday voietten engle of the ETS-II geogrationery ascellite at Lumping and Kechetung whose subschoephavir potnes locate vespectively, et 23.0°M; 121.0°E and 20.9°N; 121.1°E, and era about 200 km space. The rausits show that the spattal torrelation of TEC et equacoriei grast region is smaller than that at other plocas. The day to day voriabilities of TEC difformace butween two publicomphetin points ave gette large. The day to day veriabilities of the fourtein effort some te play an important role.

5580 Wave propagation
BRAGE PACESCATTER FROM PLASMA IMMUNICERITIES BUE TO A
FORFRIUL IUMSPHERICALLY REFLECTED RADIO-MAVE
I.A. Pajor star-offs observators, But 93%, Arcelbo,
Puersa Sica 00613), F. T. Pjuth end C. A. Sonselee
Backhareture from quaniperiodis inhomagenolties in the
electron density, generated by a powerful ionospherically
reflected wave, have been observed as tracibe. The
backgodier same nore intense by about 40 db then finit
observed soriler by other wortern at higher lotitudes.
It is suggested that the sacolous lineapheric aborption
use greater in the warlier saperiments. [ionospheric
prodification, man-made stratification, ponderopoliva
forms).

5390 Instructed and Tachniques
THE INFLECTION FOIRT METSON BY DETERMINING SIGNETER
(WIST DAY EURYS)
S. Krisbensusy, O. t. Detrivk and T. J. Rosenburg
Ilmaritute for Physical Svience and Technology,
University of Maryland, College Part, MD 207421
A computer technique is described for detarmining,
Quies Day Chree [OCC] Itom Flomesor measurements of
commic radio noise. In this townhique, the QCC value

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J. J. Sojka [Center for Atmospheric and Space Stlances, Brah State University, Logan, Stah 843111, O. t. Verban and J. L. S. Johnson [Buillerd Space Effent Laboratory, Solabury St. Hery, Dorking, Surrey, Sugles

O. t. Wrean and J.1.8. Johnson Huilard Space Streng Laboratory, Bolabury St. Mary, Dorking, Surrey, Sughani Cold proton observarions from the geosynchronous EXOS-2 ascalite are presented to show the pitch sugla distribution at the refilling cold ion population found beyond the pleasenause. This realiting cold ion population found beyond the pleasenause. This realiting cold ion population of the liux tubes from the top-side fungephere. This refilling is phoroved both day and night. The lone baws energisms between 0.5 and 2 eV. These energy characteristics are consistent with achier recent observations, tithough the abserved angular distribution of these ions is highly couplex, when allowance is used for the satelities theath several conclusions cap he sode noncerning the loop pitch suple distribution, the new first distribution, the new first distribution to very lioid dispend with a checarteristic course tone angle ranging from 10 for 20. This range of angles is consistent with checarteristic course tone angle ranging from 10 for 20. This range of angles is consistent with loss originating below 20,000 km to the avosphere rather than to the heavy-ion isnosphere. As the flux tube dosefty increase that degree of field eligament decreases, business based on the limited pitch engale deverage it is one possible to decerning if the originating below to the security of field aligned component is simply being sweeped by the local succept component or if the Itald aligned component thenges is pitch angle characteristies.

A turcial aspect of the etudy was fine evalibility of in unique data base of the ather-plasms observations. The observations were obtained by using the book busing and voltrage bissing capabilities of the detector package relative to the metallite. Those data somether and the search plasms observations. The observations has been demonstrated. If the other to be accurated in the plant and the sheath plant succepts the sagle distributions. The overall implication of the first search observations has been

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CASE STUDY RESOURTH MARNORIC AFFUR MAYES IN THE MAGRETOSPHERE: A
CASE STUDY

M. Junginger (Space Science Department of ESA/ESTEC,
Noorderist, The Netherlands). M. Bessjohenn.

Sirong days lde iong period electric and segment: fiuld
flacturations were measured emboard the geometre field
magnetic field spectre obtained throughout this day
clearly sublist discreas Frequency bends, insting
simultameounty for about five hours. The lower frequency pulsation with a typical period of 298 sec is
only present in the ulectric field data (with typical
period of 0.3 mylm), whereas the higher frequency
socilistion desimates the transverse magnetic field
spectra (typical period 95 sec, typical empittude
inf). The periods of both pulsations increase tohards she dusk sector. The observed periods of its
pulsations in conjection with the measured equetorial electron densities, the ratio of the ulectric
and agenetic field amplitudes for both frequency
bands, und the testancy of the period ratio yield
trong syldence that the boo frequency bands, und the testancy of the period ratio yield
trong syldence that the boo frequency bands represent
fundamental and taccod harmonin mode ulgan-sectifutions
of geomagnetic field lineu. The mean ratio between the
shorter and lunger periods derived frost he measurement
(about \$1.38) is slightly diffurent from theoretically
obtained ratios, thus indicating shortcomings of
currently avuilable modelu. Thu phase reletionship
between the ulectric and measurements
of the higher frequency pulsation, the direction of
the save Poynting vector, and the occurrence of the
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their observations without contradiction with the ex-latence of the 1-0 mode. It is electified that they observed both modes, fittored hillometric radiation, ray reading, propagation modes!, J. Geochys. Res., t. Paper 4,8503p

5780 wave Propagation SPULLAMEOUS OBSERVATIONS OF POS PULBATIONS BY WHP RADARS BRACED 10 HOURS IN MIT
J. O. Seys IP.E.t. Atmospheric Station, D.S. J.R.,

Lauder, Central Orago, Rev Scalandi.
Long period Pcf pulsations have been recorded simultaneously by WE reduce oreating in Scandinavia and in New Scaland. The radars are in opposits and in several and a spaced shout to hours in topol lime. Those pulsations analysed are eliter of the "quasi-regular" variety, or take the form of demped lysins which often follow magoric sudden economics. An celimetion of squalcrist liene los mase

densities shows azimulnot variations attributable to several possible causes, including the processo of localised density gradients or a algolficam proportion of heavy tone. A frampient type putention shows the affect of the two raters being directed lasting event suggests a segechronatic drive of different period on the dams and dusk flows of the magnetosphere. [Pulsution, magnetosphere, plasma dentities].

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Injested VLY waves and lightning-induced whietlers, it intense amough, are able to switze lower hybrid waves and field-sligned density attriations to the lone sphere within a jew seconds. This iontability can be slee triggered in the engagenesphare by the Injected VLY waves if the transmitter is appraised continuantly for neworal absolute Transmitter is appraised continuantly for neworal absolute Transmitter and the continuantly for neveral pressure force is the document of the transmitter of the continuant of the very barrier to the same of the continuant of the very barrier to the very barri

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#### Particles and Fields-Magnetosphere

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The RARTI'S BOW SHOW.

6. I. has [Space Science Canraw, Physics Depertment, thiwarmity of New Hempehire, Surham, NH O3824] and G. Shadron

We present a simple model unifying the distinct energatic ico populations and their essociated low fraquency hydromagnatic waves within users's ion toreshoch. Your initiality injented onto magnetic tield them at the shock serite hydromagnatic waves which pitch-angle scatter the fine back toward the about. The inner are represented by libomognanous insured [cowerd the shoch] and network travailing beams, and the transition rath between beams is determined by an effective quantilinear pitch-angle dituition confident for the transition. The internalise of seven response with the beams are encicleded from even between wave growth rates which is turn are determined by the instem veneous, local beam desairies. The coupled equalizes for the spatial and temporal evolution of the fool despities and wave lotasefties along a given magnetic tield line are solved mearitally essouring steady interested the seconsolion of the tight local to the fool jection of ions at the about following the initial eaguration of consection of the tight line to the bow shock. The initial interplendeary, waves are assumed to be unpointed on overage and to propagate pradominantly many trout the sum relative to the solar vind. We fidd thet the north as an relative to the spate to a steady, "Afticess' through the initial structure of arguetto societies, but then makes a rapid committee on a steady, "Afticess' forms a broad minimum and these leaves and informatics for the selection of a steady, "Afticess' forms a broad minimum and these leaves and interesting the size of size frictions are sonfined to spanding and have "Seg oldthay and fight he wave associated with incrementary of the selected into distribution with in any and have "Seg oldthay and fight he wave associated with incrementary to the series of size frictions are anonimed to spanding with trans whereas the ways associated with different ions and th

1. Geophys. Rus., #, Paper 448209.

Science laboratory, [Mach/Marshall Space Flight Currer, Burraville, A. 38811.

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for the full range of pitch engine and phase. We
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to proton energy. The drift velocity is approximately
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Patricia W. Belli (Department of Space Shysice and
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This paper extends to all INF orientations the
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